AD-A192 350 BENEFICIAL USES OF DREDGED MATERIAL: PROCEEDINGS OF THE NORTH ATLANTIC RE..(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS ENVIR.. M C LANDIN 1/3

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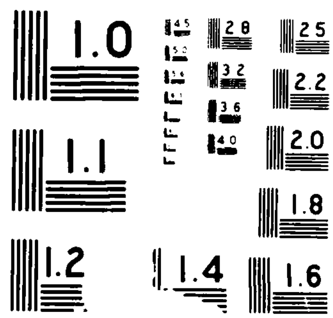
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US Army Corps
of Engineers
Baltimore
District

Beneficial Uses of Dredged Material

Proceedings of the North Atlantic
Regional Conference

12-14 May 1987
Baltimore, Maryland

Mary C. Landin, Editor

January 1988

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a REPORT SECURITY CLASSIFICATION	1b RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY Unclassified	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b DECLASSIFICATION/DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION USAEWES Environmental Laboratory / 6b OFFICE SYMBOL (If applicable)	7a NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) PO Box 631 Vicksburg, MS 39180-0631	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION See reverse. / 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) See reverse.	10 SOURCE OF FUNDING NUMBERS: PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
Beneficial Uses of Dredged Material: Proceedings of the North Atlantic Regional Conference, 12-14 May 1987, Baltimore, Maryland

12 PERSONAL AUTHOR(S)
Landin, Mary C., Editor

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Final report	FROM ______ TO ______	January 1988	235

16 SUPPLEMENTARY NOTATION
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	See reverse.

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

The North Atlantic Regional Conference on the Beneficial Uses of Dredged Material was held in Baltimore, Md., on 12-14 May 1987. It was sponsored by the North Atlantic Division, US Army Corps of Engineers (CE), and the Baltimore District, CE. The conference was attended by over 200 representatives of local, county, State, and Federal agencies, private dredging, environmental, and maritime industries, port authorities, and concerned citizens' groups.

The conference's primary objectives were to discuss past, present, and future beneficial use applications in the North Atlantic Division; to identify information and untested applications of beneficial uses of dredged material; and to contribute to the development of a logical beneficial uses strategy that can be reflected in long-term dredging planning and management. Attendees approached the conference as an information-seeking opportunity and as a chance to cooperatively discuss dredging and dredged material disposal management within the mid-Atlantic region.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL	22b TELEPHONE (Include Area Code) / 22c OFFICE SYMBOL

DD Form 1473, JUN 86 — Previous editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

8a. NAME OF FUNDING/SPONSORING ORGANIZATION (Continued).

North Atlantic Division; Water Resources Support Center, Dredging Division

8c. ADDRESS (Continued).

New York, NY 10007-9998; Fort Belvoir, VA 22060-5586

18. SUBJECT TERMS (Continued).

Beach nourishment
Beneficial uses of dredged material
Chesapeake Bay
Coastal wetlands
Long-term management strategies
Mid-Atlantic region
New York Harbor
Water resources

19. ABSTRACT (Continued).

Following a keynote address by MG Henry J. Hatch, Director of Civil Works, CE, a panel on Federal agency viewpoints was held. Six technical paper sessions followed: coastal wetlands, habitat development case studies, beach nourishment and shoreline stabilization, industrial and commercial applications of dredging, innovative uses of dredged material, and long-term disposal site problems and conflicts. Mr. Morgan R. Rees, Deputy Assistant Secretary of the Army (Civil Works), addressed attendees on the topic of the Water Resources Development Act of 1986 and its impacts on the beneficial uses of dredged material.

A day-long, highly informative field trip was held on the last day of the conference, and attendees toured Hart-Miller Confined Disposal Island in the Chesapeake Bay, Md.

SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

PREFACE

The North Atlantic Regional Conference on Beneficial Uses of Dredged Material was sponsored by the North Atlantic Division (NAD) and the Water Resources Support Center, Dredging Division (WRSC-D), through the Dredging Operations Technical Support (DOTS) Program, under the general sponsorship of the Office, Chief of Engineers (OCE), US Army. This conference addressed beneficial use applications of dredging and dredged material within the NAD and was a follow-up meeting to the First Interagency Workshop on the Beneficial Uses of Dredged Material held in Pensacola, Florida, in October 1986. Participating agencies included the US Army Corps of Engineers (CE), the US Fish and Wildlife Service, the US Environmental Protection Agency, the National Marine Fisheries Service, the USDA Soil Conservation Service, the Maryland Port Administration, and numerous State agencies represented within the NAD. Baltimore (NAB) was the host District.

The Conference Planning Committee consisted of Mr. Robert F. Gore, Chairman, NAB; Mr. H. Glenn Earhart, NAB; Mr. Thomas N. Yancey, Jr., Norfolk District; Ms. Carol A. Coch, New York District; Mr. Thomas Schina, Philadelphia District; Mr. Robert E. Carlson, NAD; Mr. David B. Mathis, WRSC-D; and Dr. Mary C. Landin, US Army Engineer Waterways Experiment Station (WES). Messrs. Steven W. Merrill and Robert N. Blama, NAB; Mr. John F. Tavolaro, New York District; Mr. William R. Murden, Chief, WRSC-D. Messrs. Yancey and Schina and Dr. Landin served as Technical Session Moderators. The proceedings were compiled by Dr. Landin and edited for publication by Ms. Lee T. Byrne, Information Products Division, Information Technology Laboratory. Conference Moderator was COL Martin W. Walsh, Jr., Commander, NAB. Messrs. Jeffrey A. McKee, NAB, and Frank L. Hamons, Maryland Port Authority, were responsible for the Hart-Miller Island Field Trip.

The conference and compilation of the proceedings were conducted under the general supervision of Dr. James Johnson, Chief, Planning Division, NAB; Mr. Harold L. Nelson, Assistant Chief, Planning Division, NAB; Mr. Noel E. Beegle, Chief, Chesapeake Bay and Special Studies Branch, NAB; Dr. Robert M. Engler and Mr. Thomas R. Patin, Environmental Effects of Dredging Program, WES; and Mr. Mathis, WRSC-D.

MG Henry J. Hatch is the Director of Civil Works, OCE, US Army, Washington, DC. BG Charles E. Williams, CE, is Commander, NAD, and COL Martin W. Walsh, Jr., CE, is Commander, NAB. Mr. William R. Murden is Chief, WRSC-D. COL Dwayne G. Lee, CE, is Commander and Director of WES, and Dr. Robert W. Whalin is Technical Director.

This report should be cited as follows:

Landin, M. C., editor. 1988. "Beneficial Uses of Dredged Material," Proceedings of the North Atlantic Regional Conference, 12-14 May 1987, Baltimore, Maryland," US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

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AGENDA

REGIONAL CONFERENCE ON THE BENEFICIAL USES
OF DREDGED MATERIAL

Holiday Inn Inner Harbor, Baltimore, Maryland
12-14 May 1987

12 May 1987

0700-0815	Registration
0830-0840	Opening Remarks--Colonel Martin W. Walsh, Jr., Commander, US Army Corps of Engineers, Baltimore District, Baltimore, Maryland
0840-0850	Welcome--BG Charles E. Williams, Commander, US Army Corps of Engineers, North Atlantic Division, New York, New York
0850-0915	Keynote Address--MG Henry J. Hatch, Director of Civil Works, US Army Corps of Engineers, Washington, DC
0915-1930	BREAK
0930-1115	Federal Agency Viewpoints Panel
	Mr. William R. Murden, Chief, Dredging Division, Water Resources Support Center, US Army Corps of Engineers, Fort Belvoir, Virginia, Moderator
	Dr. Donald W. Woodard, US Fish and Wildlife Service, Regional Office, Newton Corner, Massachusetts
	Mr. William C. Muir, Environmental Impact & Marine Policy Branch, US Environmental Protection Agency, Philadelphia, Pennsylvania
	Mr. Thomas E. Bigford, Chief, Habitat Conservation, National Marine Fisheries Service, Regional Office, Gloucester, Massachusetts
	Mr. Charles R. Terrell, Ecological Services Office, USDA Soil Conservation Service, Washington, DC
1115-1245	LUNCH
1245-1430	Technical Session I: Coastal Wetlands Panel
	Dr. Mary C. Landin, Wetland and Terrestrial Habitat Group, Waterways Experiment Station, US Army Corps of Engineers, Vicksburg, Mississippi, Moderator

Mr. George Ruddy, US Fish and Wildlife Service, Annapolis Field Office, Annapolis, Maryland

Dr. Edward W. Christoffers, National Marine Fisheries Service, Oxford, Maryland

Dr. Edgar W. Garbisch, Jr., President, Environmental Concern, Inc., St. Michaels, Maryland

Dr. Joseph K. Shisler, Cook College-Rutgers University, New Brunswick, New Jersey

Mr. Thomas A. Barnard, Jr., Virginia Institute of Marine Sciences, College of William and Mary, Gloucester Point, Virginia

1430-1445 BREAK

1445-1645 Technical Session II: Habitat Development Case Studies--Mr. Steven W. Merrill, Baltimore District, US Army Corps of Engineers, Moderator

Beneficial Uses of Excavated Material in the Chesapeake Bay--Mr. H. Glenn Earhart, Baltimore District, US Army Corps of Engineers

The Maintenance of Colonial Waterbird Diversity in the Long Island, New York Region: The Relationship of Dredging to Species Dispersal and Habitat Availability--Dr. Thomas S. Litwin and Mr. David C. MacLean, Seatuck Research Program, Cornell University Laboratory of Ornithology, Islip, New York

Windmill Point Wetland Habitat Development Field Site, James River, Virginia--Dr. Mary C. Landin and Mr. Charles J. Newling, Waterways Experiment Station

Siting Marsh Development Projects on Dredged Material in the Chesapeake Bay--Ms. Julie C. Steele, Norfolk District, US Army Corps of Engineers, Norfolk, Virginia, and Mr. Paul L. Knutson, Gloucester, Virginia

1700-1900 MIXER

13 May 1987

0800-0930 Technical Session III: Beach Nourishment and Shoreline Stabilization--Mr. Thomas N. Yancey, Jr., Norfolk District, US Army Corps of Engineers, Moderator

The Use of Dredged Material from Hampton Roads/Baltimore 50-Foot Project--Mr. Samuel E. McGee, Norfolk District, US Army Corps of Engineers

Ambrose Channel Dredging, Everybody Wins--Mr. William F. Slezak, New York District, US Army Corps of Engineers, New York, New York

Biotechnical Stabilization of Dredged Material Shorelines and Deposits--Mr. Hollis H. Allen, Waterways Experiment Station, US Army Corps of Engineers

0930-0945 BREAK

0945-1115 Technical Session IV: Industrial and Commerical Applications of Dredging-- Mr. Thomas Schina, Philadelphia District, US Army Corps of Engineers, Philadelphia, Pennsylvania, Moderator

Overview of Industrial and Commercial Uses of Dredged Material--Mr. August D. Pistilli, President, American Dredging Company, Camden, New Jersey

The Potential for Innovation in the Commercial Uses of Dredged Material--Mr. Frank L. Hamons, Maryland Port Administration, Baltimore, Maryland

Winning the Support of the Public and Local Government for Dredged Material Disposal Methods--Dr. John L. Buzzi, PE, President, Kupper Associates; Past President, New Jersey Alliance for Action, Piscataway, New Jersey

1115-1345 LUNCHEON--Keynote Speaker: Mr. Morgan R. Rees, Deputy Asst. for Policy, Planning, and Legislative Affairs, Office of the Secretary of the Army for Civil Works, Washington, DC

1330-1530 Technical Session V: Innovative Uses of Dredged Material--Mr. John F. Tavolaro, New York District, US Army Corps of Engineers, Moderator

Pilot Project for Use of Dredged Material as Sanitary Landfill Cover at Fresh Kill, New York--Mr. John G. Waffenschmidt, New York City Department of Sanitation, New York, New York

Capping as a Management Tool for Ocean Disposal--Ms. Carol A. Coch, New York District, US Army Corps of Engineers

The Benefits of Subaqueous Borrow Pits as Disposal Sites--Dr. Robert M. Cerrato and Dr. Henry J. Bokuniewicz, Marine Science Research Center, Long Island, New York

Potential Benefits of Underwater Berms--Mr. J. Patrick Langan, Mobile District, US Army Corps of Engineers, Mobile, Alabama

Soil Stabilization Using Dredged Material--Mr. Edward Marquand, Trident Engineering Company, Annapolis, Maryland

1600-1615	BREAK
1615-1745	Technical Session VI: Long-Term Disposal Site Problems and Conflicts--Mr. Robert N. Blama, Baltimore District, US Army Corps of Engineers, Moderator
	Long-Term Management Strategies (LTMS)--Dr. William L. Klesch, Office, Chief of Engineers, Washington, DC
	Dredged Material Disposal Management Plan for the Port of New York and New Jersey: Technical Feasibility versus Acceptability--Mr. John F. Tavolaro, New York District, US Army Corps of Engineers
	Alternatives for the Future--Dr. Glenn W. Kinser, Supervisor, US Fish and Wildlife Service, Annapolis Field Office, Annapolis, Maryland
	Evaluating Seafloor Impacts Using the Benthic Resource Assessment Technique (BRAT)--Mr. David A. Nelson, Waterways Experiment Station, US Army Corps of Engineers
1745-1800	Closing Remarks--Colonel Martin W. Walsh, Jr., Commander, US Army Corps of Engineers, Baltimore District

14 May 1987

0730-1400	Field Trip to Hart-Miller Confined Disposal Island, Chesapeake Bay, Maryland--Mr. Frank L. Hamons, Maryland Port Administration and Mr. Jeffrey A. McKee, Baltimore District, US Army Corps of Engineers

CONVERSION FACTORS, NON-SI TO SI (METRIC)
UNITS OF MEASUREMENT

Non-SI units of measurement used in this reoprt can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
acres	4,046.873	square metres
cubic yards	0.7645549	cubic metres
feet	0.3048	metres
miles (US nautical)	1.852	kilometres
miles (US statute)	1.609347	kilometres
pounds (mass)	0.4535924	kilograms
square miles	2.589998	square kilometres
yards	0.9144	metres

BENEFICIAL USES OF DREDGED MATERIAL:

PROCEEDINGS OF THE NORTH ATLANTIC REGIONAL CONFERENCE

12-14 MAY 1987, BALTIMORE, MARYLAND

OPENING REMARKS AND WELCOME

COL Martin W. Walsh, Jr., Commander
Baltimore District, US Army Corps of Engineers

BG Charles E. Williams, Commander
North Atlantic Division, US Army Corps of Engineers

COL Walsh: Baltimore District is hosting this conference, and I'd like to welcome all of you here today. We're very proud to be holding this conference over the next 3 days. We think that we have a very fine agenda. Generals Williams and Hatch will speak to you this morning, giving overviews on beneficial uses of dredged material. Panels have been very carefully selected, and I think you'll be very pleased with the kind of information that will be provided.

Baltimore District has a very close relationship with the Port of Baltimore and the Chesapeake Bay and has been very active in the development of the entire shipping structure throughout the bay from Norfolk to the C&D Canal. It is appropriate that Baltimore District be the host here today, with the ongoing 50-foot* channel construction and the maintenance of its connecting and side channels. There are more than 100 other navigable channels our District is responsible for maintaining. Beneficial uses of dredged material have been in the forefront in Baltimore District for many years, and we think you will see applications of that in this conference.

I hope you have had a chance to look over the agenda for the conference. We have a long list of distinguished speakers and panelists. Topics to be covered are coastal wetlands, habitat development case studies, beach nourishment and shoreline stabilization, industrial and commercial applications, innovative uses of dredged material, and long-term disposal site problems and conflicts. MG Hatch is our keynote speaker, and Mr. Morgan Rees will be the luncheon speaker tomorrow. The field trip on Thursday will be to Hart-Miller Island in Chesapeake Bay. The schedule has been carefully planned, and during these 3 days I hope you will also take time to enjoy the beauty of the City of Baltimore.

BG Williams: It is a real pleasure for me to welcome you to our regional workshop this morning. I'm very interested in the beneficial uses

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* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 21.

of dredged material, as you know. I am delighted to see the turnout, and as Marty has mentioned, we hope that this will be useful for all of us. The North Atlantic Division appreciates the opportunity to sponsor this workshop. It is only fitting that we are the sponsors, because we have major dredging projects under way that make us the centerpiece for this major endeavor by the Corps of Engineers (CE).

We hope that you will enjoy this workshop. It is designed to help improve our awareness and acceptance of beneficial use options. We have several goals:

a. To discuss past, present, and future beneficial use applications in North Atlantic Division (NAD).

b. To identify information and untested applications of beneficial uses of dredged material.

c. To contribute to the development of a logical beneficial uses strategy which can be reflected in long-term dredging planning and management.

We want to create and cultivate an atmosphere of cooperation, coordination, and communication among all participants. We all face challenges in the future because of legislative and economic restraints on the disposal of dredged material. Just as we rise to meet the challenge of the future, we take pride in the accomplishments of the past, including beach nourishment applications and created wetlands, to name a few. Presently, the CE is working here in Baltimore District with the State of Maryland to reestablish shellfish habitat in the Chesapeake Bay at Slaughter Creek and Twitch Cove. This appears likely to be very successful from several viewpoints. For the CE, there will be an unobstructed channel. For the State, there will be the benefits of a reestablished shellfish area, and for the American people, there will be the realization of economic benefits. All of us have a stake in beneficial uses. We all have the same goals--to accomplish our missions while preserving and even enhancing the environment. During this workshop, I challenge you to share ideas, put your heads together, and explore options. Please, ask the tough questions. If we all do this, we will benefit from this very useful exchange of information.

KEYNOTE ADDRESS

MG Henry J. Hatch
Director of Civil Works
US Army Corps of Engineers
Washington, DC

I am quite honored to be making the keynote address at this workshop and to be sharing my views with you on the concept of beneficial uses of dredged material. Before proceeding, I would like to express my appreciation to BG Chuck Williams, the North Atlantic Division Engineer, and Colonel Marty Walsh, the Baltimore District Engineer, and their respective staffs for their fine job in hosting this workshop. I would also like to express my appreciation to our Federal colleagues in the Environmental Protection Agency (EPA), the National Marine Fisheries Service (NMFS), the US Fish and Wildlife Service (FWS), and the US Department of Agriculture (USDA) Soil Conservation Service (SCS) for their active involvement in this conference and for the hard work the representatives of these organizations have put in to ensure its success. Also, I am especially pleased that the agenda includes participants from State governments, academic, and the dredging industry.

A major objective of this conference is to provide a regional forum in which we can share our experiences in this area, both successful and unsuccessful, as well as your recommendations for future projects and approaches. I also had the opportunity to present the keynote address for the national beneficial uses workshop in Pensacola, Florida. While we had an exceptional turnout at that workshop, it was quite apparent, and indeed it was a unanimous recommendation by the various workshop participants, that follow-up regional workshops were needed to effectively transfer information and technology. This regional conference is in response to that national workshop recommendation, and I urge each of you to take full advantage of this opportunity. A second recommendation of the national workshop was to encourage the chairpersons of each of the following sessions to provide as much time as possible for audience interaction, and I strongly support this suggestion.

When we in the CE refer to beneficial uses of dredged material, we are referring to the concept that dredged material can be disposed of in a manner that is environmentally and economically acceptable while benefits accrue to society. Certainly, the beneficial use concept is not a panacea for the disposal of dredged material, no more than is upland disposal, ocean disposal, or other available disposal options for dredged material. Each has its own set of logistic, economic, legal, and environmental limitations. However, regardless of whether one is involved in the actual dredging activity of resource management, this particular tool or concept is quite intriguing in that, under certain circumstances, it can result in a management solution that is acceptable and provides benefits to our society at large, in addition to the benefits it provides specifically to navigation. To consider that cost-savings in dredging benefits only a narrow segment of our economic life is a patently illogical thought.

Our national dredging program involves the maintenance and improvement of over 25,000 linear miles of Federal waterways that serve 130 of the Nation's largest cities and reach 41 of our 50 states. The vast majority of these navigation channels require periodic dredging to provide safe and efficient operational conditions for maritime traffic. Because of the significant economic, energy, and defense importance of this existing navigation system, it is seldom a question of whether to dredge or not, but a question of how best to dredge and handle the dredged material.

The maintenance and development of our national waterway system presently involve dredging and disposal of about 320 million cubic yards (MCY) of sediment annually at a cost of about $400 million. We estimate that another 100 MCY are dredged annually by other Federal and State agencies and the private sector. We regulate the disposal of this material under the provisions of Federal legislation.

For some time, the disposal of dredged material has been the "Number One" challenge in the management of the national dredging program, and there is every reason to think that this will be the case in the future. One perspective on the magnitude of this problem is that each year we move enough dredged material to cover the City of Washington, DC, to a depth of about 5 feet. Some of you folks are no doubt thinking that this would be the ultimate beneficial use of dredged material. However, I want to make it clear that I am not suggesting such a solution!

The volume of the annual dredging program for which we are responsible has been fairly constant over the past several years because only a few major deepening projects have been authorized by the Congress. However, the role of dredging in the United States is rapidly expanding. For about 10 years or so, the Congress has not authorized a bill for water resources projects. This was probably due to two factors--the prevailing concern over environmental protection in the early years and a provision for cost-sharing which has been under consideration for the past 5 years or so. However, this has all changed now. Congress has passed the Water Resources Development Act of 1986 (WRDA) (Public Law (PL) 99-662), which authorizes over $15 billion for water-related development, including 35 deep-draft navigation projects. The Act includes cost-sharing provisions which require the financial participation of the port authorities for a portion of both the improvement dredging and the increased maintenance dredging work associated with the deepenings. The North Atlantic region is certainly well represented in this legislation through the major port development projects at New York, Baltimore, and Norfolk.

These authorized channel deepenings will involve the removal of large quantities of excavated material which will require proper relocation. To give you an idea of the magnitude of this proposed activity, we estimate that the deepening of the channels serving Norfolk, Mobile, Galveston, and New Orleans will require the excavation of about 350 MCY of bottom sediment to provide the channel dimensions included in their general design memoranda. We do not anticipate any significant problems with contaminated material because the results of our extensive testing program indicate that the pollutants are contained in the sediment particles which are transported by currents into the channel prism, and thus do not penetrate into the virgin soil layer beneath the maintenance dredging profile. Nevertheless, because of the large volume

of material involved in the deepening projects, our environmental efforts will be directed toward minimizing the physical impacts and identifying appropriate disposal alternatives for minimizing these impacts.

In addition to this large-scale, ongoing, port improvement work, projections are being made for significantly increasing defense dredging needs in several areas along the coastlines of the country. Plans to expand and to modernize our naval defense fleet are underway. Several categories of naval vessels now entering the fleet may require significantly deeper access channels or more frequent maintenance dredging, or both. As a result,the US Navy has embarked on a program to significantly expand the numbers and types of home ports in each of the coastal regions of the United States.

Another example of expansion relates to the probable role of dredging in a number of identified waterway cleanup projects under the EPA Superfund Program. In the coastal areas alone, the National Oceanographic and Atmospheric Administration (NOAA) has identified over 100 site-specific cleanup requirements. Additional cleanup requirements within our Nation's waterway system are surfacing almost on a monthly basis. All such cleanup activities involving dredging will require a careful and thorough scientific analysis of the sediments to be dredged, appropriate dredging technology for the removal of these sediments, and appropriate alternatives for disposal.

The rehabilitation of our Nation's existing waterways and water supply infrastructure, specifically our reservoirs and associated locks and dams, is still another example of potential expansion. Many of our existing locks and dams are fast approaching their projected 50-year life expectance. That is the age, based on our experience, when locks and dams generally require either major rehabilitation or replacement. Certainly, a closely related problem now is to deal with the significant sediment accumulations that have built up behind a number of these structures in order to effectively restore water quality, floodwater storage, hydroelectric potential, irrigation, and other project design purposes. Dredging will probably play a significant role in a number of these rehabilitation efforts.

Again, sound and complete scientific information must be available to dispose of these large volumes of sediments in an economic and environmentally acceptable manner, particularly in cases where contaminated sediments are involved.

I estimate that the 35 channel-deepening projects which have been authorized under PL 99-662 will generate well over a billion cubic yards of new dredged material over the next decade or so. Needless to say, this anticipated future dredging workload will require a great deal of hard work and innovation on the part of all scientists and engineers involved in these projects to ensure that each proceeds in an environmentally responsible, cost-effective manner.

This brings me back to the concept of beneficial uses. We have seen a great deal of innovation in applying this concept over the last 10 years or so, particularly in the environmental or habitat development area. I am convinced that there is room for considerable additional innovation in applying

this concept with, in many cases, a corresponding potential for significant cost-savings over our more traditional disposal methods.

The basic concept has been with us for many years, dating back to the early 1900's, if not before. Beach nourishment is the classic beneficial use example, with which I am sure most of you are familiar. Others include use of dredged material as construction aggregate or as fill for highways for many of our major metropolitan airports such as Washington National. In addition, many instances have now been documented throughout the Nation of beneficial habitat creation using dredged material. Marsh creation, suitable nesting habitat for waterbird species, and oyster and other shellfish habitat creation are just a few of the habitat development examples that clearly indicate that dredged material disposal can often be accomplished providing environmental benefits at a reduced cost if the proper conditions are established.

There is a significant continuing demand by the concerned public for beneficial use applications. From the considerable Congressional and other correspondence which I have received on our dredging projects, it is apparent that, in many instances, the beneficial uses of our dredged material are being given the same consideration as the environmental issues. In fact, these rival the basic project purpose for attention in many cases.

Our regulations require us, whenever practicable, to fully consider beneficial use alternatives in these dredging project activities. A study recently released by the Congressional Office of Technology Assessment on Waste Disposal Practices in the Coastal Zone indicates that while over 95 percent of the total volume of sediments dredged each year from the coastal zone is environmentally innocuous and suitable for a wide variety of beneficial use applications, only about 15 percent is used each year within the coastal zone for these purposes. The actual percentage used for such purposes is probably considerably less than 15 percent.

Certainly, a basic fact of life is that logistic considerations, economics, and legal and environmental constraints can sometimes limit the application of the concept. Beach nourishment is a case in point. Institutionally, we are required to use the least costly, environmentally acceptable disposal option for our Federal projects. In cases where beach nourishment does not meet this criterion, the entity requesting use of the dredged material for this purpose is required by law to pay 50 percent of the difference in cost if for public benefit, or 100 percent of the cost difference if only for private benefit. This additional cost can often be quite significant. Wave and sea conditions in the nearshore physical regime often preclude the use of pipeline cutterhead dredges, which are the most cost-effective type of plant to provide dredged material beach nourishment. In other cases, beach nourishment requirements are not concurrent with dredging requirements, or the volumes of material do not match the beach needs.

One of the major problems and probably the most difficult to overcome is that, despite the extensive environmental research that is now available on dredged material, we still have a very real problem with the general public's perception of dredged material. People often use the terms "dredged material" and "sewage sludge" as if these materials were the same. Also, despite our extensive efforts to get the term banished from the English

language, we still frequently hear the term "dredge spoil," which has a grossly inaccurate connotation for the vast majority of sediments that are dredged.

I don't, for example, see the word "spoil" mentioned anywhere in Southern Living magazine advertisements for the Virginia beaches and Miami beaches of our country! I suggested at Pensacola, and I see from the agenda that it has caught on to some degree, that we use such terms as "excavated material" instead of "dredged material" and "placement sites" instead of "disposal sites."

In my view, if we are to realize the full potential of this concept, an essential next step is the development of a logical, technically based framework or strategy for employing beneficial uses, particularly in the area of habitat development. We in the CE take considerable pride in the fact that we have developed over 2,000 productive islands that can be used for bird nesting and as wildlife habitat nationwide, thousands of acres of new wetlands, and that we can, in fact, design and construct a wide variety of productive habitats with dredged material. However, before we can reasonably determine the full extent to which dredged material can or should be used for such beneficial purposes, we must have definitive recommendations and guidance from resource managers on physical habitat requirements for each water body and region where we dredge.

Data from the national wetland classification and mapping program which is being prepared by the FWS will be quite valuable in this effort. EPA's administrator, Lee Thomas, has recently announced his support for a proposed coastal waters strategic planning initiative by EPA's Office of Water. Habitat loss and alteration is one of five identified national priority areas which would be addressed by the proposed initiative. The NMFS has recently initiated a bold new national effort on coastal habitat restoration and rehabilitation which 11 be the subject of a separate presentation this afternoon. In addition, we recently reviewed a draft report containing a series of recommendations by an independent scientific panel to the NOAA administrator on future research directions for NOAA's ocean program. A major recommendation of that panel is that NOAA establish as an agency research priority the delineation and ecological characteristics of critical coastal and offshore habitats.

As I promised at the Pensacola national workshop, I have established a policy level CE task force which will develop and report recommendations to me for programmatic policy guidance and a national direction for the development of long-term disposal management strategies for our navigation projects. Major proposed components of this national guidance will include incorporating both Federal and non-Federal dredging and dredged material disposal requirements within these plans, consideration of both structural and nonstructural alternatives to maintain efficient navigation projects, and full consideration of the beneficial uses alternative and project-specific evaluation to reduce dredging requirements, whenever practicable. We are also continuing to give a high priority to applied Research and Development (R&D) to develop innovative dredging and disposal solutions. Application of multiple-use concepts such as mariculture for our upland disposal sites and development of nearshore

underwater berms are examples of ongoing developmental work within the CE that you will hear more about in later sessions of this workshop.

The ongoing and proposed national initiatives by the Federal resource agencies represented here today lead me to believe that we are heading in the right direction in developing this required regional information and framework.

In closing, I would like to leave you with two parting thoughts. The first is one that was emphasized by Bill Gordon, former director of NMFS and now of the New Jersey Marine Sciences Conservation, and his NMFS staff, when they initially approached the CE on their proposed coastal habitat initiative. Mr. Gordon presented us with some very detailed and alarming statistics on coastal habitat losses and reduced fishery landings nationwide. He suggested that instead of continuing to try to resolve dredged material disposal problems and habitat loss problems separately, as we have done for the most part in the past, perhaps a better approach would be to define to what extent the two issues can be resolved collectively. I think this provides us with a most appropriate direction for this effort.

My second parting thought can best by summarized by the old adage "Necessity is the Mother of Invention." As I previously stated, my feeling is that there is significant untapped potential in applying the beneficial uses concept within our dredging program. Certainly, given our long-standing and, in some parts of the country, critical problems in locating suitable disposal sites and our projected future work load, there is a definite need for innovation or invention. Our people in the field agency offices, in the trenches so to speak, are and must continue to be the true innovators in this effort. We will succeed only if we can join together and identify the common "necessity" in that expression--if ours is only to "excavate and dump," and fish and wildlife resource agencies are to "protect," we will never reach a common goal. The American people deserve better.

FEDERAL AGENCY VIEWPOINTS: OPENING REMARKS

William R. Murden, Moderator
Chief, Dredging Division, Water Resources Support Center
US Army Corps of Engineers
Fort Belvoir, Virginia

Our panel this morning will express Federal agency viewpoints. It is a pleasure for me to be the moderator of the panel because the CE is vitally interested in the topic of this regional workshop--Beneficial Uses of Dredged Material.

The members of our panel are Dr. Don Woodard of the FWS, Mr. Bill Muir of EPA, Mr. Tom Bigford of NMFS, Mr. Charlie Terrell of the SCS, and myself, representing the CE. I am Chief of the Dredging Division of the Water Resources Support Center. I will introduce each of these distinguished gentlemen in a few moments, but first let me congratulate the workshop planners and organizers on a really great job. The attendees are from a wide variety of organizations and professional disciplines, and this is what is needed to achieve our goal of beneficial uses of dredged material.

The CE has devoted a great deal of time and effort to the beneficial uses of dredged material. There are two documents which summarize our efforts in this field: (a) an engineer manual authored by Dr. Mary Landin of the US Army Engineer Waterways Experiment Station (WES) and (b) the recently published proceedings of the First Interagency Workshop of the Beneficial Uses of Dredged Material, a national workshop held in Pensacola, Florida, 7-9 October 1986. The public interest in both of these documents has been extensive. Orders for the engineer manual are approaching 3,000, and requests for copies of the national workshop proceedings have exceeded supply--we are having it reprinted. We are delighted with the response, which has included quite a few requests from the international scientific community. So, keep those cards and letters coming!

I would like to take this opportunity to announce the Second National Beneficial Uses of Dredged Material Workshop, which will be held on 27-30 October 1987 in St. Paul, Minnesota. The first national workshop held in Pensacola introduced the concept on beneficial uses and focused on all types and applications. The St. Paul workshop will emphasize inland waterways and the potential for beneficial use applications of the dredged material from rivers and lakes.

It is my pleasure to introduce our first speaker. Please join me in extending a warm welcome to Dr. Donald W. Woodard, who is currently Assistant Regional Director for Fish and Wildlife Enhancement in the Northeast Region of the FWS, with responsibility for ecological services, resource contaminants, endangered and threatened species, and wetlands inventory.

Our next speaker is Mr. Thomas E. Bigford, who is the Chief of Habitat Conservation for the Northeast Regional Office of NMFS, with both regional and national responsibilities.

Our third panelist is Mr. William C. Muir, who is the Regional Oceanographer in EPA's Middle Atlantic Region. He is responsible for all the navigational dredging and related port development in this region, as well as all marine programs, including ocean dumping and oil and gas permits.

Our last, but certainly not least, panelist is Mr. Charles R. Terrell, who is the primary water quality specialist in the SCS Office of Technology in Washington, DC. He has the key role in establishing national water quality technical policy on abatement of agricultural nonpoint source pollution, including surface and ground-water aspects.

FEDERAL AGENCY VIEWPOINTS:
BENEFICIAL USES OF DREDGED MATERIAL IN THE MID-ATLANTIC REGION

Donald W. Woodard*
Assistant Regional Director, Fish and Wildlife Enhancement
US Fish and Wildlife Service
Newton Corner, Massachusetts

In October 1986, the CE sponsored the First Interagency Workshop on the Beneficial Uses of Dredged Material. At that meeting, Ron Lambertson presented the viewpoint of the FWS on beneficial uses from a nationwide standpoint. His comments focused on the FWS views on beneficial uses and implementation of such projects from the perspective of the review of dredging projects under the Fish and Wildlife Coordination Act. Most of what Ron said at Pensacola is apropos to the mid-Atlantic area, and I will reiterate some of his comments here today.

Ron noted that in many parts of the country, navigational interests are faced with the unending necessity of removing sediments from waterways and ports only to be faced with the same problem again as additional material is deposited. He said it reminded him of the legend of Sisyphos in Greek mythology. Sisyphos, a king of ancient Corinth, attempted to trick the gods and as eternal punishment was doomed in Hades to forever roll a huge stone to the top of a high hill. Whenever he got the stone to the top, it would roll back down. The point that Ron wanted to make was that if more emphasis was placed on reducing the entrance of sediments into surface waters, the amount of necessary dredging and disposal could be reduced, and at least some of Sisyphos's eternal burden relieved.

Not too many years ago, dredged material was referred to as spoil, treated as waste, and disposed of in the most expeditious manner, with little or no regard for fish, wildlife, or recreational values. It was placed on the closest site, whether that was a productive wetland or even the site of a water bird colony, sometimes while the birds were actually nesting. Fortunately, things have changed, including our sensitivity for the environment. With the continuing losses of fish and wildlife resources and their habitats, the remaining resources have taken on added significance. In some cases, dredged material can be used to benefit these resources. The challenge is to plan for disposal from necessary dredging projects in a manner that puts the material to the best possible use consistent with resource protection goals and requirements.

The FWS commends the CE for its effort to seek and develop innovative ways to use dredged material in beneficial and productive ways. We have a shelf full of technical reports resulting from the Dredged Material Research Program (DMRP) conducted by the WES during the 1970's. These reports, in turn, have led to the recent publication of the Beneficial Uses Engineer Manual that provides guidance for planning, designing, and managing dredged

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* Dr. Woodward is now at the National Wetland Inventory Office, FWS, St. Petersburg, Florida.

material, while incorporating ecological concepts with engineering designs. It documents over 1,300 cases of beneficial uses of disposal sites in North America. The FWS has been particularly interested in the development and enhancement of habitats such as marshes and seagrass beds and nesting islands for water bird colonies. However, the opportunities for such uses are definitely limited compared with the volume of sediments that is dredged each year and the trade-offs that must be considered between aquatic and terrestrial resources.

Nesting islands for colonies of certain water birds provide a highly visible use of dredged material. Some species such as least terns and black skimmers may accept a newly created island soon after the dredging activity has ceased. In most cases, the use represents a shift of these birds from a nearby site to one that is more attractive. If the shift results in greater nesting success due to reduced predation or safety from flooding, the result is a true benefit. If the new island is allowed to grow bushes and other dense vegetation, it may eventually be used by nesting herons and other wading birds. In both cases, the birds use the site and nest successfully only if there is an abundance of small fish and other aquatic life. Both the dredging of deep channels and the creation of island habitat reduce the extent of shallow aquatic habitat in which the small fish thrive. Food supply is one important factor that determines how many nesting water birds a given area will support.

In conducting their responsibilities under the Fish and Wildlife Coordination Act, the FWS biologists actively participate with the CE and other development interests in planning dredging projects. Guidance for this role is provided in the FWS Navigable Waters Guidance of 1975 and its Mitigation Policy, published in 1981. A major component of the latter policy bases recommendations on the value and scarcity of habitat to fish and wildlife resources. Through careful planning, creation of habitat with dredged material for commercial uses such as highway construction may eliminate the disposal problem with its attendant impacts to wetlands and other aquatic habitats. Making use of it to restore or create important habitats can be a means of compensating or replacing unavoidable losses. The impacts of dredging projects that warrant mitigation include the physical destruction of benthic communities, turbidity and sedimentation, contaminated sediments, changes in water circulation and salinity, erosion of material away from the disposal site, and the smothering of benthic animals and vegetation by dredged material deposition. Evaluation of disposal options is on a case-by-case basis and must consider the existing resources at the disposal site, the resources that will be present after disposal, resources that may be attributable to the beneficial use, and overall gains and losses over time. The impacts from dredging itself must also be evaluated and appropriate mitigation provided.

A matter of growing concern these days is resource contaminants. Although most material dredged for disposal is clean, there are sites such as harbors where contaminated sediments may override any potential advantages for beneficial use and require contained disposal facilities.

Another concern of the FWS biologists is that after beneficial use options have been selected in planning, less costly traditional disposal

alternatives are substituted. For example, a habitat development plan may be dropped due to a perceived need to select a plan with a greater net economic benefit. At times, increased costs should be accepted when significant intangible benefits would accrue.

Even some well-planned beneficial uses have failed because they were not implemented as designed. It is important to ensure that beneficial use projects are properly constructed. Follow-up and monitoring are essential, and corrective actions should be quickly implemented, if necessary, to ensure that the concept becomes the reality originally planned.

In summary, the FWS supports the concept of innovative beneficial uses of dredged material and will work cooperatively with the CE and other agencies in planning and designing projects that conserve and protect fish and wildlife resources while providing for necessary projects.

FEDERAL AGENCY VIEWPOINTS:
THE NATIONAL MARINE FISHERIES SERVICE VIEWPOINT ON THE
BENEFICIAL USES OF DREDGED MATERIAL

Thomas E. Bigford
Chief, Habitat Conservation, Northeast Regional Office
National Marine Fisheries Service
Gloucester, Massachusetts

My task today is to discuss National Marine Fisheries Service (NMFS) policy toward beneficial uses of dredged material. Bill Gordon addressed this same topic in Pensacola in October, and I trust you have had access to those proceedings, so I won't reiterate his statements. Instead, I will go beyond what Bill said and focus my comments on the Northeast United States. I do have a few caveats, presented as cautions for the Northeast. The NMFS wants you to be cognizant of these pitfalls.

First of all, we are hopeful for the approach being discussed here today. We are hopeful that research will clarify the techniques and find beneficial uses of dredged material. The NMFS has a major interest in CE research; NOAA has an Estuarine Programs Office, and the Northeast Center of the NMFS is developing its own estuarine research plan. This will be a regional counterpart to the agency-wide approach. This is a new effort to bring research nearer shore, and in so doing will address problems related to fisheries and dredging. This information is one of the major contributions a resource agency can make.

So, we are willing to work together on information and technology transfer, but we do have reservations. It's only fair to point them out today. We are concerned about beneficial uses of dredged material--it's not all "beneficial," and it's not all "material." Some of it is spoil. A lot of our attitude is related to what we believe is in the public interest and what we see as beneficial. In reviewing the proceedings from Pensacola, it's abundantly clear that a lot of what is considered to be in the public interest by one agency differs greatly from what another agency considers to be in the public interest, regardless of whether the lawyers can argue one way or the other for what a mandate is! Whether you build land for a monument or an airport, there are not many places for a fish to live.

To reiterate the importance the NMFS places on restoration and creation, I'd like to highlight the CE/NMFS Memorandum of Agreement (MOA) that was signed in 1986. That MOA established a 3-year pilot study to look at specific examples of ways to create or restore aquatic habitat. We are focusing research efforts on it. Unfortunately, both agencies' efforts are being piggybacked from existing programs. There is definitely a priority need to develop better information on beneficial uses, but we have yet to put real money into it. That's a major constraint on our opportunities, and it will probably limit our success.

Hence, we proceed with optimistic realism, especially in the Northeast. Mary Landin's report mentions 350 MCY of dredged material from Civil Works projects each year, and out of that perhaps 5 percent is contaminated. I think that relative percentage is different in the Northeast. Certainly, if you factor in the yardage that comes from industrial sites and harbor projects, much of the available material is in some way compromised. Use whatever word you want to--polluted, contaminated--it's filthy in some way. In dealing with the CE and other agencies, we very often cannot find clean material to use for capping or sandwiching. Maybe with the passage of the WRDA that will change, but it has been a problem in the past.

I noticed that one of the displays in the back of the room writes about benthic monitoring of "placement sites." I guess now our disposal sites have been rechristened placement sites! That's another example of semantics obfuscating the real issue of disposing of sediments that may be contaminated. Our major concerns remain how it is used, where it is used, and how it is monitored to make sure that dredged material is used in a beneficial way and does not compromise fishery resources and their habitats.

The beneficial uses that NMFS would hope to see are more in the way of compensation and restoration of degraded areas that have been compromised either physically or chemically. It should be of low habitat value. We are not as enthusiastic about efforts to create one type of habitat by sacrificing another. If that habitat is a mud flat or coastal fringe, we have a hard time seeing the benefits from destroying it to build a marsh. The fact that something may be green does not mean it will support the kind of commercial and recreational fishery resources that we need and we depend upon in the United States to the tune of more than $15 billion a year.

That means we must consider the broadest tests to assess "public interest." We have to give greater scrutiny to water dependency. It scares me to hear the term "water-enhanced" used by real estate developers. It's nice to have a water view, even if it's not on the water. In Gloucester, 15 yards from my office, a "water-enhanced" view is where the school buses park. The bus drivers sit in their buses every day, drink coffee, and watch the harbor--that's water-enhanced. That is not the best use of a public resource.

In conclusion, we have to make this concept work, and we can make it work. I say this with optimism. The WRDA provides a lot of work for the CE on behalf of the Nation. Hopefully, it will be clean material that can be used for capping dirty material coming from other projects, including some CE Civil Works projects and many of the smaller harbor projects. I think it is a good opportunity, but we must be cautious. We should do whatever we can to generate funds to support research and monitoring efforts instead of piggy-backing on existing programs. In the NMFS, our budget has suffered so over recent years that it is difficult for us to come up with our share of the funds for the pilot studies in the MOA with the CE. The pilot studies now are limited to only two NMFS regions. It would be nice to be able to expand that--to get into the Chesapeake Bay, to work with the states, to identify new work areas, to more aggressively pursue our efforts on beneficial uses. I don't think we should compromise habitats to create a different type. I made that point earlier. We must include the true value of fisheries when we assess the public interest. In seeing the beneficial use list from Bill

Murden's talk in Pensacola, it was clear that there are a lot of public benefits from placement of dredged material, from airports to recreational sites. I don't think we have been nearly as successful in creating fishery habitat. We can build wildlife habitat, but creating fishery habitat is a different game, and that's our mandate in the NMFS.

Finally, there was a quote in last Sunday's Boston Globe newspaper by the new president of the World Bank. He was talking about the bank's historic efforts to irrigate the Sahara Desert and settle the Amazon Basin and many other efforts that have not been overly successful. He concluded that the bank had learned that "good ecology is sound economics." We should keep that lesson in mind when we consider beneficial uses of dredged material. We might have to be a little conservative in our ecological thinking, in deciding what actually turns out to be a solid economic use of that dredged material. Thank you.

QUESTION: You said you were opposed to habitat conversion. What about the conversion of upland habitats to wetland habitats?

MR. BIGFORD: I think it would depend on what the upland habitat is. NMFS has no mandates there, so it is hard for us to recommend that an upland be graded down to create an intertidal habitat. We would be stepping on the programs of the FWS or State agencies in what might be one of their higher priority areas. Also, with erosion, sea level rise, and other issues of the day, those areas may be the intertidal areas of the future. Maybe we should just let it happen naturally rather than carve it out. Our position will remain not to sacrifice one functional habitat for another. If mitigation is required, we would prefer restoring degraded habitats to their natural form.

FEDERAL AGENCY VIEWPOINTS: THE US ENVIRONMENTAL PROTECTION AGENCY VIEWPOINT ON THE BENEFICIAL USES OF DREDGED MATERIAL

William C. Muir
US Environmental Protection Agency
Middle Atlantic Region
Philadelphia, Pennsylvania

When I began reviewing Section 10 dredging projects for EPA back in 1972, the product of dredging was called "dredge spoils." Spoils, according to Mr. Webster's dictionary, are wastes which are cast off as in mining and excavating and are of little use; to become spoiled, bad, or unfit for use, tainted and putrid. Now, what kind of beneficial use can one have for something like that? I remember discussing dredging criteria with Bob Engler (Dr. R. M. Engler of WES) when EPA was developing its 1977 Ocean Dumping Regulations. I argued that dredge spoils should be treated the same as sewage sludge because they were of similar consistencies.

That is where EPA was on dredged material 10 to 15 years ago. Well, like the ad says, "We've come a long way, baby!" I just said that I once thought of dredged material as being similar to sewage sludge. In a way, they still are, in that both are now considered resources rather than wastes. In Philadelphia, we took the Nation's largest ocean sewage sludge dumper and turned it into the Nation's largest producer of compost used for vegetating strip mines that were barren for 40 years, for sod farms and nurseries, and even for home garden and lawn use. All that from a four letter word!

We have another material once considered a waste, but now a potential resource, dredged material. What changed my mind about dredged material? First and foremost was the CE commitment to conducting honest, reliable research on dredged material. The research efforts of the WES leads the world in dredging technologies. Second, not being one to miss an opportunity at self-aggrandizement, was EPA's record at reducing the sources of pollution from municipal and industrial discharges which contaminate US waters and eventually settle on the bottom to change dredged material to dredge spoil.

Over the past decade, organic loadings have grown by 12 percent in the Nation's sewage treatment plants. However, according to the Council of Environmental Quality, the actual discharges to our waterways have decreased by 46 percent due to a massive construction grant effort. In 1972, only 36 percent of US streams met their designated supporting use. By 1982, 64 percent of US waters met their designated use. To further enhance that effort, Congress recently reauthorized new amendments to the Clean Water Act of 1977 (CWA) directed at achieving even higher goals.

A good example of how dredged material isn't what it used to be relates to the Delaware Estuary. This past summer I conducted a research effort there and sampled the sediments from Trenton to Wilmington, Delaware, to measure sediment oxygen demand. This was a follow-up to a study EPA did back in 1974.

I was not looking forward to this task, as I had remembered how putrid the sediments were. Instead of finding glop on the bottom, we found sand and gravel. As a matter of fact, at several stations we had trouble getting a good sample because of numerous clams caught in the teeth of the dredge.

Unfortunately, this example isn't perfect. We still have toxic problems and significant nonpoint sources, and it may be years before all of the hot spots are cleaned up. However, the regulatory framework is in place through the CWA, the Toxic Substances Control Act, and above all, the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund).

I often get the impression CE personnel are unhappy every time EPA comes to a dredging meeting with our new toxic-of-the-month problem. There was Kepone, DDT, PCBs, PNAs, and the list goes on. In 1972, we worried about turbidity and dissolved oxygen; now it depends on what new analysis we would like to perform. How about TBT this month?

Even with toxics hanging over us, we are winning. The waters are getting better and so are the sediments that fill our waterways. With the improved environment comes improvement in our finfish and shellfish resources. This presents the resource agencies with a new challenge. As we succeed in cleaning up the water, we are now faced with declining habitat. Fish and wildlife rely upon the wetlands and shallow waters that are being lost at an enormous rate, up to 450,000 acres per year.

The CE and the EPA have been very successful in implementing the 404 Program to preserve aquatic habitat, but that's not enough. Wetlands and shallows must now be created to replace past losses. Nationwide, thousands of acres of salt marsh wetlands are being developed using dredged material. Several examples exist just down the Bay from here, such as Barren Island over on the eastern shore. Also, bird islands and oyster bars are ideal uses of dredged material.

In the ocean disposal area, there is a significant shift in that communities are now waiting in line for dredged material for beach nourishment. We are actually facing the problem in Florida in which the State will no longer sanction ocean dumping and is forcing the CE to dump their "spoils" on the resort beaches!

I should point out that EPA supports WES's continued research in the creation of artificial wetlands and other aquatic habitat. Efforts such as these will play a major role in returning the biological integrity of the Nation's waters. Further, we would recommend that these research efforts be directed toward the long-term viability of artificial wetlands.

Last, where does EPA go from here? I gave a talk 2 weeks ago to the National Association of Port Authorities in which I began with the old joke of the three biggest lies. Well, I'm here to tell you that I'm from EPA, and I'm here to help you. We've put our money where our mouth is, so to speak. We have joined with the resource agencies in developing enhancement plans which actively support justifiable port development and navigation projects by providing up-front mitigation and compensation to assure timely and economical solutions. I've brought a few copies of the Baltimore Harbor and Philadelphia

Port plans for anyone interested and can provide names of the contacts if any of you are interested.

In summary, major strides have been made in enhancing the environment. Dredged material must play an increased future role, and EPA is committed to working with the CE to assure that this is accomplished.

FEDERAL AGENCY VIEWPOINTS:
BENEFICIAL USES OF DREDGED MATERIAL FROM A SOIL CONSERVATION SERVICE PERSPECTIVE

Charles R. Terrell
National Water Quality Specialist
USDA Soil Conservation Service
Washington, DC

I would like to open this morning by telling you that oxymora are all about us; they are with us every day. No, I'm not calling anyone a bad name. I'm not making fun of anyone's reputation. Perhaps, you've heard about oxymora; they are popular items in speech-writing these days. Examples are "cruel kindness," "pretty terrible," "awful good," "mandatory option," or "voluntary regulation." An oxymoron is a figure of speech that is seemingly contradictory, such as "legal brief." Or how about "government intelligence"?

Now to my point. To this list of oxymora I would like to add another, namely "wet land." It might seem more like an oxymoron if I said "water land," but nevertheless in many people's minds the idea of water and land are contradictory. If you have water, you can't have land; if you have land, it must be free of water. It's no wonder that wetlands have been a contradiction and a source of argument for centuries!

Let me say a few things about wetlands and the SCS. SCS supported and is working to implement the Wetland Conservation Provision, also called "Swampbuster," of the 1985 Farm Bill. This provision says that farmers and ranchers will lose USDA payments if they produce commodities on converted wetlands, if that conversion took place after 23 December 1985.

On the technical side of abating agricultural pollution, SCS will be examining the possible use of natural or man-made wetlands to treat agricultural contaminants. Wetlands, especially man-made ones, offer a potential for inexpensive treatment of these pollutants. Wetlands in some parts of the country are already treating municipal wastewater, so it is likely that the technology can be applied to agricultural situations.

Next, I want to discuss some of my personal experiences concerning the uses of dredged material. I will relate an experience I had about 9 years ago. At that time I was working for EPA on the kepone contamination in the James River, Virginia. For those of you who are not familiar with the situation, kepone was a pesticide used on bananas in Central America and on vegetables in a few other countries. It was manufactured in a former gas station by a "subsidiary" of Allied Chemical in Hopewell, Virginia. Through intentional dumping, the chemical contaminated virtually the entire James River below Hopewell. As a result of its activities, Allied Chemical was given the largest fine in the history of the Clean Water Act to that time, approximately $13 million.

In our investigations to find potential cleanup or mitigation measures, we and the Norfolk CE District studied dredging methods, both domestic and worldwide. We believed that one of those technologies, called the Oozer Dredge of the Takenaka Company in Japan, might offer a way to mitigate some of the environmental effects associated with dredging. We went to Japan and saw the Oozer Dredge and other technology of the company.

I have been away from the dredging scene for some years now, but the dredging technology that I saw in Japan was the most advanced and environmentally sound that I have ever witnessed. While swinging in a large arc, two large "heads" at the dredge's bow literally sucked up bottom sediments like a giant vacuum cleaner. There was little disturbance of the area around the dredge's operating head. The bottom material was moved to a disposal area as a semisolid plastic mud, not as a liquified stream.

What else was the Takenaka Company doing? They were making new land from dredged material. While probably there are few US places where new land is being created on a large scale, it is happening in Japan. At one harbor, our hosts took us to an enclosed former estuarine area that had been filled with dredged material from the harbor. They invited us to walk onto the surface. You really have a strange sensation walking on a surface that not too long before had been oozy mud, perhaps more than 10 feet deep. They called in a backhoe and dug a hole to show us the approximately 1 meter of solidified surface. The company stabilized the area through a chemical "cementing" process and the use of a giant "eggbeater" that injected the solidifying chemicals. They said they would be able to construct a two-story building on the newly created land, and in Japan that is very important.

I point out some of these items to illustrate technologies available and being used today. I don't advocate dredging unless it can be done in an environmentally safe manner. I don't advocate filling water bodies because, as a biologist, I personally believe we need these areas to maintain our natural resource productivity. As an example, let me add a footnote to my Japan story. On one of our trips, we visited a fishery research station on Japan's coast. The Japanese scientists told us that they no longer had a coastal fishery, so they were forced as a nation to search the world for fishery products. I suspect that I saw the reason for their coastal fisheries loss as we traveled the length and breadth of Japan. Every river we crossed had its banks riprapped for as far as the eye could see. Every lowland had long ago been converted to rice production. In fact, when we started to discuss wetlands with our Japanese counterparts, we had great difficulty translating the word and concept of "wetland." Admittedly, the word "wetland" is a relatively recent English word, so we tried "swamp," "bog," "fen," and finally "marsh," to which one of the Japanese said he knew of a freshwater marsh somewhere in the interior of the country. I hope we never reach the point in this country where our children will never know what some of these valuable resources are because we did not have the foresight to protect these natural resources.

Back home and on a different topic, the SCS has been developing plant materials used to stabilize erosive soils, including dredged material. Plants are nature's way of healing, protecting, and beautifying the landscape. SCS's Plant Materials Program receives hundreds of plant species from around the world each year and grows them to determine which varieties or "cultivars" can

be used o reduce soil erosion better than the plants we currently know. Plants are chosen for their ability to thrive under adverse conditions, such as drought or cold, saline or alkaline soils, insects or diseases, or flooding.

Finding plants to solve conservation problems is the job of 23 Plant Materials Centers (PMC). Our closest PMC is at Beltsville, Maryland, and was established in 1938. Of more than 200 conservation plants released by the Plant Materials Program over the years, more than 150 are presently being produced commercially by seed growers and nurseries. Each variety was released for a specific purpose, whether for improved forage for livestock, protecting farmsteads from blowing soil, revegetating surface-mined land, or stabilizing streambanks, roadsides, and coastal dunes.

The PMC at Cape May, New Jersey, has evaluated plants for stabilizing dredged material. I will point out several factors about this work. Dredged material with salt concentrations in excess of plant tolerance may cause them to die. However, if dredged material is allowed to leach salts for 1 or 2 years, the area can probably be successfully planted with common types of vegetation. Some dredged materials contain pyrites, yielding oxidized sulfur compounds and producing very acid soils. Stabilizing these sites is best accomplished by covering them with 4 to 6 inches of nonacid soil. Lastly, dredged material without salt or acid problems can be quickly vegetated, either by planting or by volunteer species.

An SCS booklet of interest to this group is "Plants for Coastal Dunes of the Gulf and South Atlantic Coasts and Puerto Rico." While the plants are oriented to southern climes, the booklet discusses dune formation, coastal climate effects and soils, sand-trapping devices, surface mulches, access walkways, and other vital information needed by coastal workers for successful stabilization.

I would like to conclude with a few thoughts about SCS's role concerning dredged material. With tongue-in-cheek, I could say that SCS has been trying for 50 years to make it unnecessary for the CE to stay in the dredging business. From a simplistic view, if soil erosion protection were 100-percent effective, there would be little or no need for dredging. However, we live in a less-than-perfect world, a world in which sediment does originate from our lands and is deposited in our waterways. The more soil that we can protect and keep on the land, the less sediment and associated pollutants that will enter waterways to clog channels and fill reservoirs.

The programs of the SCS and the CE are complementary, rather than competitive. A good example of that cooperative spirit is just outside our door, where on the Chesapeake Bay the SCS is actively working to reduce soil amounts entering the bay from agricultural and urban lands while the CE is working on shoreline erosion protection. Other Federal and State agencies are likewise doing energetic work in their respective areas. The cooperative, interdisciplinary example set by the Chesapeake Bay effort is one that will have to be followed closely in the future as we attempt to address other natural resource problems around the country. If there is one concept that former Senator Mathias of Maryland knew, it was that only through the

cooperative efforts of many agencies, acting simultaneously and together, that the cleanup of Chesapeake Bay be accomplished.

For this reason the SCS and the CE must continue to work closely together to reduce the amount of sediment reaching our waterways. We must have cooperative programs that help prevent soil erosion to keep sediment in its place.

QUESTION: What do the Japanese have in the cement they use in dredged material?

MR. TERRELL: To the best of my knowledge, they used cement, but they did refer to it as a chemical process, so there was more than just cement involved. To them, this stabilization was a priority, and what they made their bread-and-butter money on; they never told us exactly what went in there. I brought one article with me about the process, but it's written in Japanese with English subtitles. As a matter of fact, I did try to find some of my slides from Japan, and I was unable to locate them in time for the meeting.

QUESTION: Did they talk about whether plants would grow in the soil they make out of mud?

MR. TERRELL: I don't know about that. Perhaps you'd like to talk to Curtis Sharp, our plant materials person who deals with the soils and the plants in relation to dredged material. I can give you his phone number.

MG HATCH: I would imagine what the Japanese are doing is what we refer to in the United States as soil/cement stabilization, which in construction is an expensive way to make a roadway out of soil without paving it. We do that quite a bit. For stabilizing a disposal area, it could be rather expensive unless one is intending to do what they did and use it for major development. You build some strength into the soil, which that dredged material didn't have by itself.

QUESTION: How about soil permeability? Did it percolate at all?

MR. TERRELL: Actually, I can't give you an exact answer, but as the backhoe dug into the soil, it appeared very porous and did not appear to be like rock or cement.

QUESTION: How large an area were you looking at?

MR. TERRELL: At least the size of a football field. They also used the process for breakwater foundations. We visited a site in Tokyo Harbor where they had cordoned off an area and were using the giant eggbeater in open water about 20 to 40 feet deep. They went to the bottom and stirred up the bottom sediments and the chemical mix with the beater. This made a very hard base. They then put breakwater stones on top of this base. It was a very interesting construction process.

QUESTION: Could you explain SCS's role in Swampbuster?

MR. TERRELL: I don't deal with SCS's programs, which is where Swampbuster (the 1985 Farm Bill) is being administered. I work on the technical side, and there are SCS regulations that are coming out under programs. To be perfectly honest, there is quite a bit of controversy as to what should be in those regulations. I don't want to try to relate to you exactly what is in there because that's not an area I work in. If you want a direct contact, I can give you the names and phone numbers of persons working on this. They can tell you what is in the draft regulations better than I.

COMMENT: With regard to the Japanese process, it costs about $35 per cubic yard. It's very expensive.

MR. TERRELL: As MG Hatch indicated, you don't use this process on all land areas. In Japan, land is very very expensive, so the economics are there to justify this stabilization technique.

MR. MURDEN: I am familiar with that process you describe, and the CE has information on equipment and techniques. If anyone needs that information, it is available. One of our speakers tomorrow will describe this capping process in the United States.

QUESTION: What about the possibility of incorporating dredged material into soils for its agricultural properties?

MR. TERRELL: It can be done. Problems that may be encountered are any contaminants in sediments and excess salinity. There may be chemical interactions that affect crop growth. Those are the questions that must be answered.

MR. BIGFORD: I wanted to raise a challenge to everyone. I know in the Northeast we run into problem dredged material that is so contaminated that we wonder if we should allow open-water disposal or open-coastal use such as marsh development. We need to clarify research techniques and criteria to figure out if something fits into that "clean" dredged material category or is contaminated. That is something Bob Engler and others at WES are working on. It's a responsibility that NOAA shares. There's a lot of dredged material that our agency, at least, thinks is contaminated. We wouldn't recommend placing it in the ocean, but other agencies think it could be placed as open-bay disposal. There is a big difference in the criteria, tests, and agency position.

QUESTION: Did I understand you to say that you would not categorize dredged material for the replacement of natural or existing habitats as a beneficial use?

MR. BIGFORD: NMFS would prefer to restore habitat where the existing habitat is of very poor quality, such as the part of the Hackensack Meadows that is all *Phragmites*. It's not very productive, and we don't have problems giving it up for mitigation, for example. Conversely, if it is a productive mud flat, we don't want to see a grassy marsh on it.

MG HATCH: I respectfully submit that although the exchange in and of itself may not be beneficial, that if there is a requirement for project implementation to mitigate the loss of a habitat, that the provision in and of itself may be beneficial if it is part of a broader project. It may also be more economical to the American taxpayer.

MR. BIGFORD: Let me get into mitigation. One of the problems with mitigation is that agencies oftentimes don't have the time or money to ensure compliance with all permit conditions. They also have problems with the success of mitigation techniques. This is an area where we have to do better, including the applicants for permits, not necessarily in Civil Works, but in the regulatory program. Part of the enforcement burden falls on all agencies, with the CE in the lead.

QUESTION: One of the recommendations of the Pensacola workshop was that we should find ways to implement beneficial uses even if it is not the least costly method. I'd like to know if anything has been done to change the "least costly alternative" method of doing business.

MR. MURDEN: In Pensacola, we discussed that under the present CE guidance we had to look for beneficial use options that corresponded with least costly but environmentally sound options. That remains the case. We have to prove our point on beneficial uses to Congress and others. To me, the proceedings from Pensacola and the proceedings to be published here at this workshop will go a long way in explaining to Congress that beneficial uses have wide diversity and applicability. We still have that bridge to cross.

MG HATCH: The WRDA has an obscure section in it that would authorize the inclusion of environmental enhancements in CE projects by making the flat statement that these enhancements will be assumed to be economically justified. That is a neat thing, and it does exactly what you ask if it is executable with a constrained Federal budget. If it would be recommended to Congress in the appropriations process, it would give us the funds to do beneficial uses in the project. My personal view is that although Congress has authorized enhancement, no administration, including the present one, will see fit to pursue that with much vigor when it sets budget priorities. On the other hand, because it is authorized, Congress and future administrations have the continuing opportunity to include that in funding requests and authorizations. The notion that tinkering with the cost/benefit ratio computation of projects is in the interest of environmental enhancement or mitigation has continued to go away when anyone has tried to sit down and develop particular legislation to accomplish it. It's the reason for the section I just mentioned. Theoretically, in application of a project, an environmental enhancement could be exempted and apart from the computation of the cost/benefit ratio. That is where we are today, but I would not expect that any administration would recommend significant contributions for that provision.

QUESTION: I have heard the terms "innocuous," "uncontaminated," "potentially contaminated," "contaminated," and others. What are agency perspectives for criteria for determining whether dredged material is suitable for beneficial uses. Where do you draw the line?

MR. BIGFORD: Most of the people at NMFS have no problems with the criteria, but with conducting the proper tests with the right critter for the right length of time in the right laboratory setting that gives you an answer that everyone is going to believe. Most often, it's the 10-day bioaccumulation test people don't believe, because they suspect that if you left it for 14 days, a problem would show up.

QUESTION: So you are saying that a standard criterion is just a standard bioaccumulation test?

MR. MUIR: From EPA's standpoint, we have come full cycle on this issue. We dealt with it back in the 1970's. At that time we were trying to develop individual sediment criteria for individual contaminants. WES and EPA both worked on this. EPA is trying to produce sediment criteria right now. We need this information; however, we are going back to the bioassay technique. In the ocean dumping program, it's the bioassay technique that is most useful. EPA is refining those techniques instead of just looking at static bioassays. We have microcosm studies looking at individual organisms and their communities and what affects them. The bioassay technique is becoming much more sophisticated. We are also looking at intermediate testing levels, enzyme reactions, how the cell actually reacts within the organism. There's a lot going on right now. I would like to see regular bulk sediment criteria, but it's not going to happen. Instead, we are going to rely on the much more sophisticated bioassay techniques. There's some thought going to applying medical industry techniques to our criteria and analyses.

MR. DAVID NELSON: The CE has been doing bulk sediment analyses and bioassay in the aquatic environment at WES. We are completing the Field Verification Program, where we took three different disposal sites and looked at them in upland, wetland, and open-water habitat conditions. We looked at dredged material constituencies, site conditions, and organism bioaccumulation.

QUESTION: I agree with that, but it is very expensive to do bioassays. We'd like to have a compromise between bioassays and other techniques.

MR. BIGFORD: To that point, in the Northeast, Federal and State agencies have gotten together to develop what they call "harbor characterization." It has not been totally implemented, and the CE report is in a late draft stage. The concept is to gather all relevant information on a harbor to create a solid data base, and then compare the sediments for each project to the historic base. This will save additional time and money for all parties. The report is supposed to be tested in New Haven Harbor, but hasn't been yet.

QUESTION: Is SCS directing their attention to farmers and others toward the re-creation of bottomland hardwoods and other wetlands associated with cleared farmland?

MR. TERRELL: The Swampbuster Provision is aimed at slowing down if not stopping conversion of wetlands to agricultural land. This goes into effect with conservation compliance in 1990. If there is conversion of wetlands after that time, the farmer will lose his benefits.

QUESTION: Is SCS providing technical services for re-creation of wetlands?

MR. TERRELL: Our technicians are certainly capable of doing this. However, I cannot give you specific examples. We have four technical centers around the United States--Philadelphia, Fort Worth, Lincoln, and Portland. We have a biologist in each state, and all of those people are trained in wetlands. However, we can only withhold funds from farmers who are destroying wetlands. We can't stop them--that's a private action, not an SCS action.

MR. MURDEN: In concluding, I'd like to address the beneficial use of habitat for finfish and shellfish. One of the papers to come later in the workshop addresses a site in Chesapeake Bay where an unproductive bottom area was enhanced using dredged material for oyster habitat. It will be monitored to see if it does become productive. Another example will include eelgrass production important to softshell crabs in Chesapeake Bay. I wanted Mr. Bigford and all of you to know that there will be two presentations on aquatic habitat using dredged material. In addition, I remember a young man from FWS (Mr. Richard Berry) who sat next to me in Pensacola and who said he didn't speak well to large crowds. He was very nervous. He then proceeded to give one of the best papers in the entire meeting, on Weaver Bottoms. We are going to concentrate on such areas for the next national workshop in St. Paul.

One other item--a new dredging research program is getting under way at WES in FY 88. It is a 5-year, $35 million program and will concentrate on dredging equipment and operational methodology, but will be closely tied to beneficial uses as well. I want to thank BG Williams and COL Walsh and COL Reirdon, and all their staffs, and everyone who has had a part in putting together this workshop. I especially want to thank the Federal agency panelists this morning for their comments and participation.

COASTAL WETLANDS: OPENING REMARKS

Mary C. Landin, Moderator
US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

I want to thank North Atlantic Division and the Baltimore District for hosting this very important workshop on the beneficial uses of dredged material, and thank each of the speakers in this panel for being willing to serve as panel members and give their agencies' viewpoints on coastal wetlands. The topic of coastal wetlands is an extremely important and thought-provoking one that was brought to the workshop planning sessions by all four Districts within the North Atlantic Division, with requests for a session from the resource and regulatory agencies with which those Districts work. We on the panel represent various veiwpoints which reflect the mission and work of our agencies and offices. We are all aware of the pressing need for cooperation, coordination, and communication among our offices, especially with regard to natural resource problems and environmental impacts. Each of us works with coastal wetlands, and we are looking forward to your questions and discussion following our opening statements.

With that in mind, I want to introduce each of our panelists. Opening our panel will be George Ruddy, who works in the Annapolis Field Office, representing the FWS. George has worked on various water resource development projects over the past several years, with emphasis on dredging.

Following George Ruddy will be Ed Christoffers, who is chief of the Habitat Conservation Branch at the Oxford Laboratory, Maryland, representing NMFS. Over the past 17 years, Ed has served in the NMFS regional Gloucester, Massachusetts, office and at Ann Arbor, Michigan.

Our third panelist, Ed Garbisch, is unable to be with us today. Ed is president of Environmental Concern Inc., of St. Michaels, Maryland. Ed is recovering from a very serious bout of Rocky Mountain spotted tick fever and sends his regrets. Ed planned to represent the private viewpoint on coastal wetlands and dredged material beneficial use applications.

Joe Shisler of Cook College at Rutgers University is our fourth panelist and represents the academic side of the coastal wetlands viewpoint. Joe has worked in coastal wetlands and mosquito research and biocontrol for a number of years.

The fifth coastal wetlands panelist is Tom Barnard, who is a research scientist at the Virginia Institute of Marine Science (VIMS), College of William and Mary, and who represents a state viewpoint. Tom has worked on numerous coastal wetlands sites in Virginia, including CE sites such as Windmill Point in the James River.

I will wrap up with a coastal wetlands viewpoint from the CE and the potential for beneficial use of dredged material in wetlands. After our brief remarks, we will open the session to your questions and comments.

COASTAL WETLANDS:
COASTAL WETLANDS FROM A US FISH AND WILDLIFE SERVICE PERSPECTIVE

George Ruddy
US Fish and Wildlife Service
Annapolis, Maryland

Good afternoon. As a biologist with the FWS, I am involved in the planning and evaluation of the CE nagivation dredging projects in the Maryland portion of the Chesapeake Bay. Most of the dredging from these projects is associated with the maintenance of existing channels. The major environmental concern is how to dispose of the dredged material. This problem is growing more acute all the time because the better disposal areas are being used up and new environmentally acceptable areas are becoming increasingly difficult to locate. In light of this, it becomes even more advantageous to search for beneficial ways to utilize the material.

Marsh creation seems to be one of the most often mentioned beneficial uses of dredged material. At first glance, it is an appealing option. Tidal estuarine and salt marshes are known to be of high value to fish and wildlife resources in coastal areas. The methodology for marsh creation is fairly well etablished. Despite this, marsh creation as an option for dredged material disposal has seldom been utilized in the Maryland portion of the bay.

There are several reasons for this. Many areas are not suited for marsh creation because of the presence of a high wave energy climate. In the more protected areas, the creation of the marsh would come at the expense of shallow water habitat, which is considered ecologically valuable in its own right. Shallow waters provide nursery and adult feeding habitat for a variety of fishes. They may also be utilized by waterfowl, shorebirds, wading birds, and others. They may have significant benthic resources, including some of commercial importance such as oyster or clam bars. The presence of submerged aquatic vegetation with its high ecological value would be another reason that would discourage marsh creation.

Apart from these biological considerations, landowner opposition can also be a problem. The presence of piers, mooring areas, or other boating-related activities pose a conflict. Another limitation is that marsh creation sites generally cannot be used for disposal more than once. This is an important factor considering that most of the dredged material comes from projects which require regular maintenance.

So, in actuality, there is a variety of reasons why marsh creation is not utilized more frequently for dredged material disposal. Nevertheless, there are situations where it can be a good alternative. I think it could be appropriate in areas where there have been declines in the native marshes. Those declines may have resulted from either natural or man-made causes, and in a general sense marsh creation could be viewed as offsetting

some of the previous losses. For example, marsh creation could be beneficial in urban areas where the original marshes have been destroyed as a result of past development activities.

Marsh creation could also be desirable in areas where reducing the erosion rate of an upland area is an important objective. It could perhaps be utilized in higher energy areas in combination with some type of breakwater for erosion control purposes. It also could be beneficial in fortifying natural bay barriers where breaches threaten to disrupt the sheltered areas behind them. Some examples of this are certain islands, peninsulas, marsh spits, or bay barrier islands which protect the areas behind them from high wave energy. Some of the Chesapeake Bay islands come to mind as valuable wildlife habitats which are being diminished by erosion. These would certainly benefit from the added protection afforded by a marsh creation project.

In conclusion, while it is unlikely that marsh creation will ever be a common method for dredged material disposal in Chesapeake Bay, I believe it does have a place as an alternative, and we should be alert for situations where it could be a viable option worth pursuing.

COASTAL WETLANDS: THE NATIONAL MARINE FISHERIES SERVICE ROLE IN COASTAL WETLANDS

Edward W. Christoffers
National Marine Fisheries Service
Habitat Conservation Branch
Oxford, Maryland

Dredging has been conducted within our estuaries and coastal zone since colonial times. However, unless we control silt at its source, the need to dredge and dispose of this unwatned materual will escalate as man continues to develop the coastal zone. Unfortunately, the "beneficial uses" concept can solve only a small fraction of the overall disposal problem.

We have heard from several speakers about the CE/NMFS. NMFS views the MOA as an opportunity to interact cooperatively for the benefit of Chesapeake Bay and ecosystems within the Northeast in general. If we are to succeed in our combined agency missions, we have to cooperate in planning and implementaiton of beneficial use projects. Unfortunately, in the past, and under the present MOA, NMFS has had to operate with very limited funding. Funds for these experimental projects have come from cost-savings within the projects themselves. As a result, NMFS has not been able to conduct the necessary baseline or follow-up studies needed to ensure that productive habitat was created or that our goal was accomplished. HR 6 (PL 99-662) is one avenue of funding for fisheries enhancement projects using dredged material, and I encourage the CE to use that avenue for funding beneficial use projects.

Technology exists to create marsh, mangrove, seagrass, and intertidal nonvegetated habitats using dredged material. However, only in a few instances do we know the relative value of the habitat that is being lost due to the disposal activity. We need to develop a reasonable definition of "success." If we build a "green" wetland, it has been considered successful. However, our Southeast region has indicated that fish abundance and production may not be as high as in a natural wetland. In the proceedings from the Pensacola workshop, Tom Minello and Mark Fonseca of NMFS argue convincingly for the need for more work on artifically created wetlands. One reason for these studies is that, although we can build a marsh, we do not know how to measure precisely or replace the values being lost at the marsh creation site. Our definition of success must include ecological concepts, not just floristic success.

We need to devise a mechanism for measuring "success" using an ecosystems approach in evaluation of beneficial uses. All habitat types (e.g., shallow water, mud flats, etc.), not just vegetated wetland habitats, have intrinsic values. Most of us in the estuarine sciences do not have adequate data to clearly characterize the appropriate habitat mix. Therefore, we simply cannot exchange one habitat for another without knowing how the site fits into the ecosystem just because there is an opportunity for a beneficial use experiment. For example, menhaden, an extremely important commercial species used for fish meal and oil, assimilate detrital material, but we do

not know precisely how many acres of wetlands and other habitat types are required to sustain stocks of menhaden.

If we are to fully utilize the beneficial/alternate use concept of dredged material disposal, we need to develop sound ecological data. There is a "need to know" about the value of the habitat that is being displaced. We cannot simply say a bottom is unproductive simply because it is not vegetated, nor does it necessarily follow that the replacement system will be more productive or be of greater nursery value than that which is being displaced. If we are to gather this information, we must develop plans to acquire preproject baseline data, devise postproject monitoring plans, and establish performance and evaluation procedures. We must continue to evaluate existing and potential habitat replacement technologies and beneficial uses of dredged material, but with strong experimental designs and quantitative follow-up research, rather than with speculation based on nonquantitative sampling or no sampling at all.

Many of the early beneficial use projects within the Chesapeake Bay area, including Barren Island, Slaughter Creek, and Quinby, were not fully successful or failed because we did not have adquate planning, execution, and/or follow-up. We need to select project sites carefully and provide sufficient funding to conduct the needed preproject and postproject studies. Funding must be up-front, long-term, and a part of the project base funding, not achieved only from project cost-savings. In short, we need to make the beneficial use process a full partner in the dreding program.

In summary, we in the Northeast region have reservations about the beneficial use program because (a) research results indicate that created wetlands are not as productive as their natural counterparts and (b) studies show that wetlands created for mitigation/compensation in the permit program generally have not been fully successful. However, we view coastal wetlands development, utilizing the beneficial use program, as an opportunity to interact cooperatively with the Corps to broaden the knowledge base and ultimately to enhance fisheries resources.

COASTAL WETLANDS:
COASTAL WETLAND HABITATS AS A BENEFICIAL USE OF DREDGED MATERIAL*

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and

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Environmental Connection, Inc.
Perrineville, New Jersey

Maintenance of waterways by the removal of dredged material is an old and ongoing process in the United States. However, there have been major changes in the handling of this dredged material over this period. In the past, dredged material was often deposited on the nearest aquatic, wetland, or upland area. Along the Intracoastal Waterway of the United States, there are a number of these dredged material deposition sites which today serve valuable functions in the estuarine ecosystem. The noncontained placement of dredged material has yielded to contained sites in many areas because of impacts upon the wetlands and intertidal habitats. Many of these deposition sites in New Jersey have been developed in various ways to meet the needs of the coastal development.

Historically, many of our major cities have been developed at the expense of wetlands and estuarine systems. The fill used in the development of the cities has, in many cases, been dredged material from adjacenet waterways. In "Life and Death of a Salt Marsh," Teal and Teal (1969) state that approximately 50 percent of Boston is constructed upon former wetlands and intertidal areas. In his keynote address, MG Hatch spoke of the current development of Japan's ports with the use of dredged material, which is probably a practice similar to that which occurred in our ports in the past. The construction of major ports will have to continue to address the removal and placement of dredged material from waterways in an environmentally appropriate way.

Seventy-five percent of the United States population will be located within 100 miles of our shorelines (including the Great Lakes) by the year 1990 (Gordon 1986). This concentration of the human population will increase the pressures upon coastal resources. All of New Jersey is within this 100 mile zone, and it is the most densely populated state. New Jersey is a relatively small state, but is fourth in acreage of tidal wetlands behind Louisiana, Florida, and North Carolina (Alexander, Broutman, and Field 1986). Two major ports, Newark-New York and Philadelphia-Camden, are located on the Hudson and Delaware estuaries, respectively, that bound the state. A

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* This paper was taken from the New Jersey Agricultural Experiment Station Publication No. R-40502-01-87, which was supported by State of New Jersey funds.

challenge in the future is the continual development of these ports and surrounding coastal areas without environmental damage. The removal and placement of dredged material from these waterways will present interesting problems that will demand creative thinking and design if these major ports and others are to continue to function. Lack of placement sites, toxic materials, and the cost of transportation to an appropriate site are some of the problems associated with dredged material removal.

Present State and Federal coastal zone management programs consider the loss of wetlands as a major issue and have implemented regulations governing the impacts upon these habitats. Development pressures in these coastal areas have resulted in a shift from the wetlands to the old dredged material areas as sites for development, since they do not fall under many existing regulations. However, if these sites are now developed, where will the future dredged material be placed?

The creation of wetland habitats from the proper deposition of dredged material is viewed as a solution to this problem by both coastal zone management personnel and the public. But a lot of factors have to be considered before such a solution is deemed feasible (US Army Corps of Engineers 1986). The most appropriate locations for the creation of wetlands are in areas presently subjected to daily tidal inundation. The placement of dredged material in these locations inundated by daily tides can easily be colonized by vegetation and produce a wetland habitat. The research by WES has addressed many of these factors in the recent US Army Corps of Engineers (1986) publication by Dr. Landin.

The loss of an important habitat has created friction among the various agencies and groups with respect to their individual interests. For example, management of dredged material and the use of the sites by various avian species in the coastal waterways have become major issues. If certain wildlife species are to utilize these areas, there has to be a periodic application of material to keep a desired successional state. The research in North Carolina has been very important in understanding the impacts of the management of coastal avian populations (Soots and Landin 1978). Unfortunately, the problem with the data generated to support such a program remains in the organizational proceedings. The information has to be presented in a variety of areas for a general acceptance and incorporation into future management plans.

What are the unanswered questions associated with the development of coastal wetland habitats? The major questions are what is the type of habitat to be restored/created/enhanced, and can it be done? Certain wetland habitats are more easily manipulated, while others will require additional work and care in their management. The systems requiring additional management concerns are located above the normal tidal cycle (Shisler and Charette 1984). The management practices towards these habitats may require additional data to understand their functions before they are incorporated into construction plans.

The creation of wetland habitats for various reasons has been occurring for a long time. The production of rice is an excellent example. The wetland habitat for rice production can be found on the sides of mountains in various

countries that only receive rain during certain months of the year. The aquaculture of the Orient for fish production is yet another example. The management of wetland habitats for the increased production of waterfowl and fur species has been a major component in the FWS programs for a long time. The creation of wetlands adjacent to roads or in storm-water facilities without any planning is another example of wetlands creation. The rice culture is an example of the extreme case in human energy input to keep the system functioning, while wetlands resulting from construction of roads and storm-water facilities are examples of minimum energy inputs.

A wetland habitat has to be able to maintain itself if it is to be a viable habitat for any period of time. The research on this aspect has not been fully implemented with certain wetland systems. For the most part, the creation of wetland habitat has been done in the warmer climates of the country where such factors as toxic substances and ice are not significant problems. Toxic materials in sediments are not always stable and can be translocated into the plant tissues and exported. The aspects of management of wetlands in urban areas are perhaps the greater challenge.

Recent research in New Jersey addressed the issue that certain coastal wetland habitats should not be created as part of mitigation since they were the ones with the greatest number of failures (Shisler and Charette 198'). The high marsh habitat was one of these habitats. Here, variation in the elevation is so small that nay minor deviation can result in the area becoming a low marsh habitat or upland area vegetated by *Phragmites australis* (common reed). The factor of tide range also affects the wetland management issue. The smaller the tide range, the more critical the design for management of the elevations for vegetation zonations has to be. When the wetland is created, problems will arise immediately if the elevation is not correct. Fine-tuning of the system can be conducted after one growing season.

Questions concerning the comparison of wetland management data have shown that in many cases, mitigation for wetland projects has not been effective. There are many reasons for the failure of the system to function properly. The creation of wetlands is not as easy as a lot of people had thought. The evaluation of past projects around the Nation would provide a data base for the development of programs in the future. Many of the projects evaluated in depth have been large projects funded by the US Army Corps of Engineers not involving mitigation. The small or more common permit-based projects may continue to be the focal point around which the success of these created systems is judged.

The source of information needed for the management of wetland habitats is provided in a number of publications. The recent publication of the US Army Corps of Engineers is an ideal place to begin. However, site-specific information is needed for an individual project. Both the Lewis book (1982) and Zedler report (1984) are additional soruces, but these publications address primarily the warmer climates of the Nation and forget the urban and suburban areas of the Northeast. The major question remains: How do we manage the very limited coastal wetlands resources of the Northweast, when the population pressures are estimated to continue to increase?

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COASTAL WETLANDS:
WETLANDS AND THE BENEFICIAL USE OF DREDGED MATERIAL: A STATE PERSPECTIVE

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I don't know if MG Hatch is still here or not, but I wanted to say that I could appreciate his comments about dredging jargon and that, in the interest of good State-Federal relations, I was going to promise not to "spoil" his conference!

I must begin my talk this afternoon by saying that I do not bring the totality of the Virginia perspective on wetlands and the beneficial uses of dredged material to this panel, but rather that of a State environmental scientist and technical advisor. As a scientist at VIMS, for 15 years I have dealt on a daily basis with the myriad of coastal management and policy questions raised through State management of wetlands and subaqueous lands. I interact with the CE on an almost daily basis through the State Wetlands Protection Program, which closely parallels the CE implementation of Section 404 of the Clean Water Act in Virginia's tidal waters, and also the CE dredging program, which in many cases must have State subaqueous permits.

We have, I believe, a very good working relationship with the CE and the Federal advisory agencies in Virginia. We have a monthly joint processing meeting where we exchange views on wetlands permit applications, and we have bimonthly dredging management meetings where the Federal project channels that the CE maintains within Virginia are discussed. Although we do have State-Federal policy disagreements from time to time, breakdowns in communication on the part of one side or the other are the cause of much of our State-Federal disunity when it does occur.

With that introduction, I will move on to the subject at hand. Any discussion of wetlands and the beneficial uses of dredged material must eventually come down to the feasibility of wetland creation. And although I am quite skeptical about this subject within the State and Federal permit program for reasons I don't have time to go into in this paper, I believe wetlands creation has its greatest, though limited, potential within the context of the Federal dredging program. I say limited potential because wetland creation and enhancement is not a panacea. It is not applicable or even desirable for all dredging projects. Each dredging proposal is unique, with each having its own technical, environmental, and socioeconomic problems which must be resolved.

The use of wetland creation is also limited because many major questions with regard to the feasibility of wetland creation remain to be answered. Such questions as: How do we measure the relative ecological value of the existing habitat versus that to be created? How do we measure success in habitat creation? What are the environmental impacts of the creation process itself? At what point in time does a created marsh reach

functional parity with natural marshes of the same type? In other words, how long does it take to create a mature marsh? Technological advances in wetland creation have in some cases outstripped our ability to predict the consequences of our actions with the result being that we often find ourselves relying on theoretical assumption in our environmental analysis. We have not evaluated the success or failure of existing attempts at wetland creation from a holistic standpoint. Very few artificial wetlands have been monitored on a long-term basis. We have not planned wetland creation in an ecological context. The result is that we have not established that man-initiated wetlands in general provide an overall net benefit to the environment.

As more emphasis is placed on expanding the beneficial uses of dredged material, the opportunity exists to address many of the unanswered questions surrounding man-initiated wetlands through expanded State-Federal cooperation and interaction. Accomplishing the necessary preliminary studies, creating the wetland, and monitoring after construction should be part of any dredging project which incorporates wetland creation. Such studies must be carried out if wetland creation is to graduate from its present experimental mode to one of useful management tool.

Wetlands creation also has potential in that it may environmentally enhance existing disposal practices. We are presently exploring the creation of a different wetlands type in Virginia where we have a Federally maintained channel called the Waterway on the Coast of Virginia, which runs inside the barrier island chain for the length of Virginia's Eastern Shore peninsula. A number of different disposal techniques have been utilized over the project life, but generally the dredged material has been placed overboard a safe distance from the channel. Over the years it has been noted that where the dredged material has reached the intertidal elevation, oysters have become established serendipitously. Virtually all oyster rock on the seaside of the Eastern Shore is intertidal.

Over the past 4 or 5 years, we have recommended in our discussions with the CE and the Virginia Marine Resources Commission (VMRC) that the feasibility of using dredged material to create new intertidal oyster rock be explored. Virtually everyone involved agrees that this may be a highly beneficial use of dredged material. The VMRC, VIMS, and the CE are at present trying to resolve the many problems involved with such an undertaking. Questions awaiting resolution are:

a. What is the present ecological value of the proposed disposal area?

b. How can we maximize the potential for oyster rock creation? What conditions need to be created?

c. How should we monitor reef development after disposal?

d. How can these enhanced areas be incorporated into Virginia's oyster management program? Are any changes necessary?

e. How can the CE maintain its self-imposed 50-year disposal plan if the disposal areas become active oyster rock and are presumably no longer available for dredged material disposal?

f. How will we pay for the additional costs associated with oyster rock creation?

Because this is a Federal project with State interest from both a channel maintenance and resource enhancement standpoint, I believe the potential exists to conduct the research and resolve the questions surrounding the feasibility of this beneficial use of dredged material. If the questions iterated above can be resolved, this beneficial use of dredged material may have applicability to other areas where oysters are grown intertidally.

Whether we are ever able to realize great benefits from marsh creation or not, it is very important that we continue our efforts to improve the dredging process and to make better use of dredged material in the environment. We must continue to strive to reduce the degree to which we adversely affect the marine ecosystem. Our environment, due to ever increasing population pressures and our expanding technology, is less able to cope with our abuses now than even 10 short years ago (witness the Chesapeake Bay Program). In addition, our environment is less forgiving now. Our mistakes are more costly. There is less room for poor judgment.

Thank you very much for the opportunity to address you today. I look forward to the question and answer period on our panel.

COASTAL WETLANDS:
COASTAL WETLANDS FROM A CORPS OF ENGINEERS PERSPECTIVE

Mary C. Landin
Waterways Experiment Station
US Army Corps of Engineers
Vicksburg, Mississippi

Background

The CE has become involved in decisions regarding coastal wetlands as a result of the Clean Water Act of 1977 (CWA), the National Environmental Policy Act of 1969 (NEPA), and a number of other laws and regulations affecting CE Congressionally mandated responsibilities. In recent years, the CE has been the permitting authority for dredge and fill activities in wetlands (Section 404 (b) (1), CWA) and in open water (Section 401, CWA), and it is responsible for the preparation of Environmental Impact Statements and Environmental Assessments for projects under NEPA.

At the same time, the CE has the responsibility for disposing of over 360 MCY of dredged material annually, which will increase to over 1 billion cubic yards over the next decade due to authorizations for harbor and channel improvements in the Water Resources Development Act of 1986 (WRDA) and the US Navy's Homeporting Program. The CE has in the past, and plans to continue in the future, to dispose of dredged material so that it is used in beneficial and productive ways. In fact, the new draft dredging regulations, as well as the WRDA, have many references to beneficially using dredged material that is suitable for conventional disposal. Since only about 5 percent of all material dredged each year is contaminated, there is great potential for benefically using much of the remaining 95 percent. In fact, the CE is in the process of developing a long-term management stragegy (LTMS) concept for dredging and dredged material disposal that includes strong emphasis on beneficial uses. The natural resources management framework is now in draft and in CE field office review. This framework stresses multiple uses, careful coordination, the development of interagency working groups for each LTMS, planning for dredging regions and not just project-by-project, long-term monitoring, allowance for cumulative impacts and losses, and periodic review.

I am going to talk this afternoon about coastal wetlands and the CE, not from a legal perspective, but from a technical perspective. We are all aware that the United States is losing vast acreages of wetlands, especially in places like coastal Louisiana, where they are losing 50 square miles annually to subsidence and erosion. Within the mid-Atlantic region, wetlands are viewed as critical areas that must be protected from loss and degradation. The level of efforts put into water quality improvement and wetlands protection in the Chesapeake Bay, for example, is testimony to that concern. Where in the Gulf Coast States we think of wetlands on a magnitude of hundreds of acres, in the mid-Atlantic states, a half acre marsh is considered valuable and worthy of protection--an area to be saved. If such an area is lost, it is

not unusual to see requirements in public notices from your CE Districts for wetlands restoration and mitigation by the tenth of an acre.

Why the CE Builds Wetlands

One of the questions you have heard asked earlier today concerns wetlands mitigation and the CE role in this. Many people believe the CE builds wetlands solely for mitigation, which is not true. We build habitats, wetlands included, for a number of reasons, all related to accomplishing CE work. The CE builds wetlands for shoreline stablization, for erosion control, for flood levee stabilization, to prevent sediment from reentering the shipping channel (thereby reducing the need for dredging), for fish and wildlife habitats, for hurricane and surge attenuation, for water quality, for streambank buffer zones, and for mitigation. At WES, in addition to those reasons, we also built wetlands throughout the United States during the 1970s and 1980s to develop and test wetlands development and restoration techniques at demonstration sites for anyone who may have need of that information, whether they be from a CE office, the FWS, the NMFS, a State agency, a local harbor committee, or whomever. The information and data are available to all who ask, and the CE has provided them freely upon request for years. In any given year, we may receive several hundred requests for assistance on wetlands and beneficial use projects.

The CE views wetlands as highly sensitive areas that are undergoing change due to a multitude of sources: nonpoint source pollution; land development; intense human pressure from industrial, urban, agricultural, and recreational use; sea-level rises; changes in tidal and riverine hydrology from man-induced causes; and other factors. The CE also must deal with the fact that it is obligated to maintain US channels and harbors--which means dredging--which means finding adequate disposal sites, working with resource and regulatory agencies to prevent or lessen environmental impacts, and using the dredged material in ways that will enhance and protect natural resources.

The CE looks at using dredged material not as a waste product, but as a displaced soil or sediment that has great potential for beneficial or productive use. We have numerous examples of prior beneficial uses and are actively working to continue such uses. We are aware that dredged material cannot be used for intertidal wetlands development in all disposal projects, but under certain conditions is entirely feasible. There are many other ways dredged material can be used other than for intertidal wetlands that you will hear about over the next 2 days. However, coastal wetlands development has been shown to be a viable technique, not just for mitigation, but for all of the previously stated reasons--shoreline stabilization, erosion control, and others. The CE has 13 years of documentation that shows over a long-term monitoring effort increases in wildlife use and diversity and enhancement of fisheries and benthos in wetlands it has built. These data include predisposal, ongoing dredging, and postdredging impact assessment. In field sites where the CE purposely built tidal channels or river current flow-throughs into the site design, there were significant increases in before and after aquatic use. The CE has learned a lot about wetland development and restoration both from successes and failures. <u>The problem arises when the</u>

right techniques are not applied, or applied improperly. This is true whether it is a CE-built site or a privately built mitigation site.

Wetland Criticism

The CE seems to be receiving the most criticism over wetland mitigation. This occurs most frequently at sites where permit applicants were required to build or restore a wetland as mitigation for one they would destroy by their permit action, and these wetlands are not always built of dredged material. The CE does not generally follow these mitigation requirements through from their initiation to their completion because regulatory offices often do not have manpower or funds to do so. The CE also does not design mitigation plans for permit applicants--they must either plan them in-house or go elsewhere for these designs. The CE is presently monitoring selected wetland mitigation sites in Florida and New England (both coastal and interior) to determine the success of mitigation at randomly selected permitted sites.

I have read papers and reports where new man-made wetlands built for mitigation were compared with decades-old natural wetlands and found to not be as productive. We have in fact made the same comparisons, but have found that properly built wetlands compare very well with natural wetlands. There are two fallacies in the former conclusion that I have observed: (a) wetlands, like any other dynamic system, need time to reach "maturity," and (b) a new man-made marsh and a new natural marsh are not necessarily different in their productivity. Those who conclude that a new man-made marsh and an old natural marsh should be equal without weighing other factors are comparing apples and oranges. Time differentials in soils formation, root biomass, and other ecological parameters have to taken into consideration. I maintain that if you compared a new properly built man-made marsh with a new natural marsh, you would find great similarities. I should also point out that Federal resource agencies are also aware of this time differential and as a result may sometimes require additional mitigation to counterbalance this.

Summary

Man-made wetlands, for whatever reason, should not be viewed as the only answer to wetlands problems regarding coastal development. However, man-made wetlands, and in the case we are discussing today, wetlands made of dredged material, have their place within the scheme of things. Where a wetland is eroding, where a shoreline needs stabilization, where a wetland is being lost--all of these are good reasons to consider building coastal wetlands. The CE plans to continue with its consideration and use of dredged material for building and/or nourishing wetlands when appropriate conditions exist for wetlands enhancement, protection, or management.

As an afterthought, and in response to questions raised today, the CE continues in some cases to dispose on sites where wetlands have been built. These cases include wetland nourishment, thin-lift disposal, and additions to existing marshes. We also do not automatically conclude that because a wetland did not achieve the level or type of development or stability that we originally projected it would, a site is not a "success." There are

lessons to be learned from all habitat development efforts, including man-made wetlands. We have learned much about techniques, biostabilization, erosion control, achieving correct elevations, habitat development, monitoring, costs, and other aspects of wetlands--this important information was not all gained from "successful" sites--and as was often the case, the actual site development served its intended purpose of creating wetlands, of achieving stabilization, or of developing habitat.

QUESTION: I have a question for regulatory and permitting agencies. Do you feel that beneficial uses will be used properly, or be used as a justification for a project that would not otherwise be permitted? What criteria would be used in judging this?

DR. CHRISTOFFERS: I don't see that beneficial uses would ever be allowed to justify a private project. It will have very little effect on the regulatory process.

MR. BARNARD: I'd like to go into that more. What we are talking about today is really separate and distinct from the regulatory process. There, you are looking at mitigation, functions, and values, etc. of wetlands. Here, you are talking about the best ways to use dredged material, which may not be just dumping on an upland site. It might include a chance for wetland development. I see a large distinction between the two.

MR. RUDDY: Projects should be justified on their own merits, and the mitigation should not be used as a way to further project approval. There is little potential for quality control--Mary just touched on this in her remarks--it is very hard in private permits to see that quality control is carried out. The major problem is part of the permit system itself.

DR. CHRISTOFFERS: If I may expand on George's comments, in the regulatory permit system, we in NMFS use the term "water-dependent"; i.e., is it required to be on the water to be successful (port, marina, terminal, etc.)? If it meets that test and has broad public interest, and there are wetlands that will be destroyed, and it is the only practical alternative after all considerations, including redesign, then we talk about mitigation. Mitigation is not used to tip the balance for or against a project. In our Southern region, Gordon Thayers says they use 3:1 or 2:1 ratios for wetlands mitigation where created wetlands will not be as productive as natural wetlands.

DR. LANDIN: This does not mean that they won't be as productive over time, just that they may not be at the outset. Any well-designed and -built wetland should compare favorably with a natural wetland over time.

DR. CHRISTOFFERS: That's what I meant. A large part of man-made wetland failure has been in poor technical design, failure to establish guidelines and set success criteria. It is not that intentions weren't good and the CE didn't have proper specifications; it's that a contractor won't follow those specifications, or that the elevation may be wrong, or other problems. That's what we have to watch out for.

DR. LANDIN: This is always likely to be a problem. Let me point out an in-house CE problem that we have identified and are trying to correct. Our planning people and our operations people draw up designs and specifications for projects, contract the work, and dredging inspectors are responsible for seeing that these specifications are exact and that elevations are correct. By the time that many steps have been carried out, there is room for slipups. Some Districts have a great deal of problems with getting exact specifications carried out. In the New Orleans District, for example, they often have varying elevations that will become high marsh, low marsh, upland, etc., rather than all low marsh. Down there, however, they build so much marsh, and their loss and subsidence problems are so great, that no one gets really excited over a slipup of a few inches in elevation. In Chesapeake Bay, however, incorrect elevation or any slipup by a dredging inspector can be much much more critical.

QUESTION: How many other agencies are involved besides the CE in coastal wetlands? It seems to me we have adversaries here, with NMFS, FWS, CE, and others, and I don't understand the relationship. Please explain the difference.

COL WALSH: I'm trying not to be defensive here! We do have two Federal environmental agencies on the panel. All three agencies have vested interests. Federal dredging falls under both regulatory and operations in the CE, so we look at dredging from both viewpoints. Where private, State, and local sponsor dredging is concerned, it mostly falls into regulatory. The CE also would like for projects to stand on their own, and mitigation should not swing the decision. Where both economic and environmental concerns are major, however, projects have to be weighed carefully to achieve a balance between jobs and community improvement and wetland impacts. A balanced solution may be the answer. It's the CE's responsibility to consider all possibilities and alternatives and try to determine what is best for all concerned.

DR. LANDIN: In answer to your question, I guess you may have to call us friendly adversaries. We do work together, and we do occasionally have differences of opinion, but all three agencies try to do what's best based on our own agency's mission and the taxpayer's interests, and so do the State agencies. We selected this panel to have a broad representation within the NAD. Joe is from New Jersey and represents university, state, and private interests. Tom is from Virginia and represents university and state concerns. Ed Garbisch was going to represent private interests. Ed Christoffers, George, and I represent the three Federal agencies who work more in coastal wetlands than any other. It may have come across that we are adversaries, but we didn't intend it that way.

COL WALSH: We are "balancers."

QUESTION: I'm a bit concerned. There is an environmental agency concept here that our Operational Management (O&M) budget can be used to fund basic research. It isn't supposed to be that way. We can use funds to determine pertinent information necessary to carrying out a project, but not basic research. I don't understand why Ed or George would think the CE can get that money out of our construction funds when they can't get approval for it from

the Office of Budget and Management themselves. With cost-sharing, we have to now ask our local sponsors to help pay for this. We need to rethink some of these areas. If you can't justify the cost for this basic environmental research in your own agency budget, what makes you think I can justify it in my construction budget in Norfolk District?

DR. LANDIN: This is the same question that Carol Coch from New York District was asking this morning. How do you justify, get the authority, the funds to collect baseline data? Ed and George have a dilemma in that they sometimes have to turn to the CE for research and monitoring funds. In the CE, we have sometimes "sneaked in" some environmental monitoring in projects in O&M budgets that wouldn't have been there otherwise, by the grace of the Project Officer or District Engineer.

DR. CHRISTOFFERS: In the course of a project that is going to alter the environment, there is an acquired obligation to show that what you are doing is right and appropriate. That should be justification enough for paying for environmental baseline data collection. It's time the American public owned up to the actual costs of development projects. We owe it to future generations.

DR. LANDIN: The CE doesn't disagree with that. We realize that to determine project success in terms of the environment, you must monitor and evaluate the project. We just have to figure out ways to collect that data since this is generally not authorized by Congress in dredging budgets.

DR. CHRISTOFFERS: This problem is in the Federal budgetary process, and it should be corrected.

DR. LANDIN: WES has always encouraged monitoring as part of project costs. A number of Districts do this. They may not collect all the data that it would be good to have and that regulatory and resource agencies would like to have, but at least they are collecting most essential data at project cost.

QUESTION: Isn't it true that monitoring should be included in the budget based on current regulations?

MR. SAM McGEE: On individual projects, data for that project can be paid for with no real problem. It's when we are asked to pay for a study away from the project area that I balk.

DR. CHRISTOFFERS: We appreciate CE funding on these broader studies, which we believe have project impacts.

DR. LANDIN: State/Federal interactions are an area of concern in coastal wetlands among many States and CE Districts. I'd like to ask Tom and Joe if they could comment from their positions in States on this.

MR. BARNARD: In Virginia, we have a system of local Wetland Boards of five to seven people who rule on wetland applications. There is quite a variation as to how these Boards function. Virginia concerns and Federal concerns are pretty much the same. We have monthly CE and Commonwealth meetings to

discuss wetland problems, and we do have case-by-case differences between the Commonwealth and the CE.

DR. SHISLER: In New Jersey, our regulatory people handle all State/Federal interactions, and I don't see the day-to-day interaction. I hesitate to comment for them.

QUESTION: Why do you not allow high marsh to be built in New Jersey?

DR. SHISLER: I think high marsh would be a failure anywhere it's created, but it definitely is in New Jersey. The tidal range factor controls our wetland development. The high marsh zone is really very small--less than a foot. Elevation is very critical, and construction guys are very bad about not achieving this. Most marshes will develop a high marsh zone anyway.

DR. LANDIN: Another reason in New Jersey for not building high marsh is that they tend to become *Phragmites* marshes if you aren't very careful.

DR. SHISLER: We do have that problem, and in other regions, they have other high marsh problem species.

QUESTION: Has much been done in the area of wetland mitigation banking?

DR. LANDIN: For those who may not have heard this term, mitigation banking is mitigation in advance and offsite, where habitat enhancement or development is done with the intention of using it as mitigation for some small or future project. It hasn't been done in many cases.

MR. BARNARD: We have one 8-acre intertidal marsh in Virginia built from an old borrow pit by the highway department in 1983 for mitigation banking. I am monitoring that marsh for them. Its purpose is to offset almost daily impacts on small wetlands in highway work throughout the Commonwealth.

DR. SHISLER: Mitigation banking adds to the level of bureaucracy. I think we have too new a technical field, and too little wetlands expertise exists, to do some of the things with wetlands that need to be done.

DR. LANDIN: That is an institutional memory problem--there aren't too many old timers in the wetlands field to know what went before and what can go wrong with a project. Ernie Seneca and others at North Carolina State who planted wetlands on dredged material in the late 1960's and early 1970's were the first ones to try this. In fact, the CE got the idea that we could build wetlands on dredged material from their work--that is where it all started.

MR. RUDDY: Mitigation banking is used for <u>minor, unavoidable</u> wetland losses that cannot be mitigated onsite. FWS doesn't look at this as a potential for trade-off. It can't be used for "buying a permit" and is not really applicable to dredging projects--it's a regulatory process.

QUESTION: I am puzzled--I got the impression from two speakers that wetlands development was not of much benefit and from the others that it was of value. Then I heard some discussion about not building them right!

I guess I have a couple of questions. Do we have criteria for building wetlands? If we develop criteria, are they going to be available for permit applicants?

DR. LANDIN: The Engineer Manual has designs and specifications for building wetlands--everything from elevational grading to species selection, to planting and propagation, to costs, to monitoring. It has not been distributed on a regular basis to permit applicants by CE regulatory people. We are actually talking about two different things here: CE maintenance or new work dredging projects, and private permit-requiring projects.

QUESTION: I didn't hear a distinction earlier in the kind of wetlands that are failing.

DR. LANDIN: Most of the wetlands that have not been successful are those built in the permit approval process, not built or monitored by the CE, and not necessarily involving dredging. There was no follow-up to ensure that the permit applicant actually built the wetland as instructed to do. Examples of this can be found in Florda, where permit applicants were supposed to be building mangrove wetlands and failed to get elevational and other criteria correct. They wound up with poor quality high marsh. Jacksonville District has been so concerned over this lack of success of some of these mitigation sites that it has asked WES to monitor randomly selected wetlands to see what went wrong and what can be done to improve the situation. WES is also doing this for the New England Division.

DR. CHRISTOFFERS: There are actually three levels of wetlands: WES-built sites, other CE-built sites, and regulatory permit sites. The latter are usually done by the lowest bidder, who may or may not know what he is doing in a wetlands. We don't always get what we pay for, or maybe we do! Contractor's error can account for most of these identified wetland failures.

DR. LANDIN: To me, this is a failure of us CE biologists who know how to build wetlands for not getting the technology out to those who need it, whether they are permit applicants or another agency. I'm very serious about this being our responsibility, and we get requests for assistance at WES from Districts frequently, asking us to help permit applicants or agencies with beneficial use applications and habitat development work.

COL WALSH: Wait a minute, Mary--I have a bag full of ashes in my office waiting for you! It's not just our responsibility; it's everyone involved's responsibility. In Baltimore District, I am responsible for permit violations and problems. In our regulatory program, we have <u>one</u>, count him, person on the Eastern Shore in regulatory. We have <u>one</u>, count him, person in central Pennslyvania in regulatory. Most violations are reported by concerned citizens, and we work like "Have Gun, Will Travel." We tell those permittees to change it--we will stop contractors and permit violators dead in their tracks. In Baltimore District, we have about 2,400 permit applications a year. Most are routine, but several hundred each year involve detailed action, including providing the applicant with suggested changes. I make the final decision on permits, and I will say "No" maybe a dozen times a year. We work carefully with resource agencies. I don't see us as adversaries at all.

DR. LANDIN: That's all the time we have for questions. Thank you for your interest and attentiveness. Please find us outside and ask more questions if you have any. Any of us on the panel will be glad to continue the discussion.

HABITAT DEVELOPMENT CASE STUDIES: OPENING REMARKS

Steven W. Merrill, Moderator
US Army Corps of Engineers
Baltimore, Maryland

I would be absolutely remiss this afternoon if I did not mention the Chesapeake Bay. I hope that you will all take time to look at the displays along the walls before you leave today. The CE has been involved in the National Chesapeake Bay Restoration Program for 2 years now, and as a member of that Program, we sit on the Regional Management Committee, which is struggling to develop a concensus of opinion and a regional approach for water resource management in the bay. We see the CE's role as lending technical expertise in water resource planning, operations, and regulation. The CE is signing a joint venture with EPA to develop the first three-dimensional water quality model of the Chesapeake Bay. We are hoping this will link the hydrodynamics with the water quality dynamics of the bay to give us a scientific measuring stick between waste load reductions and improvements in water quality.

You have just heard a very stimulating discussion on coastal wetlands in the North Atlantic region. Now, we are very fortunate to have a group of speakers who will talk to you about their habitat development and enhancement studies involving dredged material. First we will hear from Glenn Earhart, Baltimore District Operations Division, who will present an overview of three habitat development projects in the Chesapeake Bay, including Barren Island.

Our second speakers are Tom Litwin and Dave MacLean, with the Seatuck Research Program at Cornell University, who have been conducting studies on seabird nesting on dredged material sites in Long Island Sound and who will give you an idea of what is presently taking place and the potential for future nesting.

Mary Landin, whom you have already heard in the previous panel, is our third speaker and will present a paper on the Windmill Point habitat development field site built in the 1970's by Norfolk District and WES. Long-term monitoring research has been taking place there for the past 13 years. It is one of 11 CE habitat development sites where long-term monitoring is taking place.

Julie Steele of the Norfolk District and Paul Knutson, a private consultant, both formerly with the Coastal Engineering Research Center at Fort Belvoir, Virginia, have made detailed examinations of existing dredged material wetlands in Chesapeake Bay to determine siting success and other criteria. They will be our fourth and final speakers for this afternoon. Please give our speakers your attention, and feel free to ask questions.

HABITAT DEVELOPMENT CASE STUDIES:
BENEFICIAL USES OF EXCAVATED MATERIAL IN THE CHESAPEAKE BAY

H. Glenn Earhart
US Army Corps of Engineers
Baltimore, Maryland

The Baltimore CE District has responsibility for approximately 90 Federal projects throughout the Chesapeake Bay (Figure 1). These Federal projects vary in size from the deep water port in Baltimore with project depths of 35 to 50 feet to a number of smaller projects. Ports also occur at Salisbury, Maryland, located on the Wicomico River, with a 14-foot depth, and the Nanticoke River at Seaford, Delaware, with a 12-foot depth. There is an abundance of District projects with Federally authorized depths of 6 to 9 feet. These projects provide access for commercial watermen to the productive shellfish and finfish resources of the Chesapeake Bay.

The District's dredging program removed approximately 3.7 MCY of excavated material in FY85 and 4.4 MCY in FY85. The most significant problem encountered by the program is the placement of the excavated material in an environmentally acceptable manner.

Resource and regulatory agencies within the District preferred, and generally accepted as a disposal option, placement in a confined upland site. However, several problems exist with the utilization of an upland disposal site. The upland sites are required to be within 2 miles of the excavation areas due to economic considerations. As a result, upland sites are usually prime waterfront properties or agricultural land. If an upland site is utilized, the property owner must expect the site to be unproductive for several years until the material can dewater, unless costly dewatering techniques are implemented to hasten site reuse.

It has become imperative that Federal, State, and local agencies and offices consider and evaluate innovative uses of excavated material. Any identified innovative placement option requires similar scrutiny from resource and regulatory agencies. The District routinely coordinates with numerous Federal agencies, including the NMFS, EPA, the FWS, and many State agencies, including the Wildlife, Fisheries, Wetlands, Coastal Resources, Health and Mental Hygiene, and Historic Trust departments within the State. The entire Chesapeake Bay resource community must and has taken an active role in endorsing innovative concepts of excavated material placement.

Historically, the Baltimore District has utilized the beneficial use concept in a variety of applications. In 1972, the District stabilized the excavated material resulting from the Federal Project at Honga River, Dorchester County, Maryland, by creating 4 acres of *Spartina alterniflora* emergent wetlands using seeds.

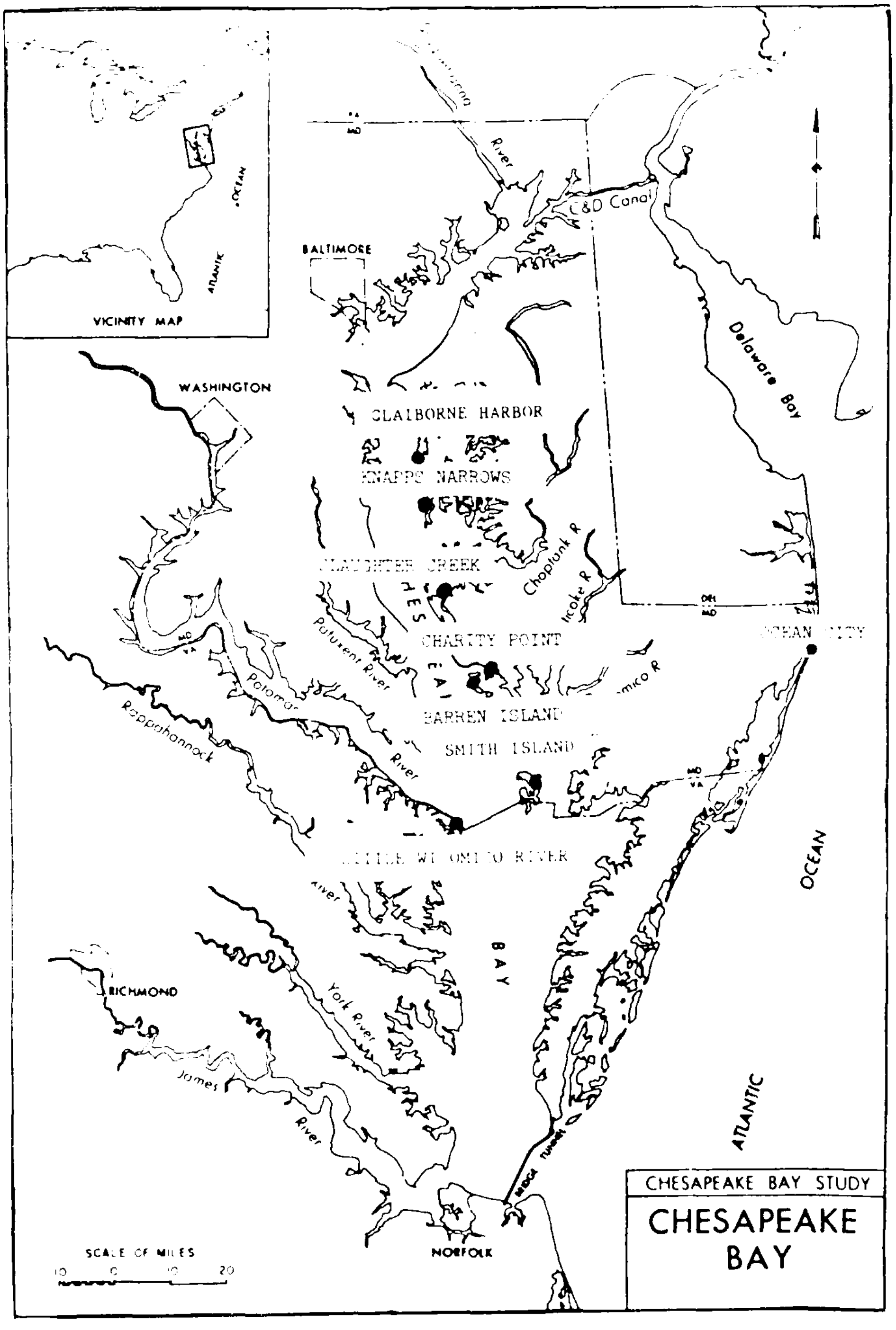

Figure 1. Locations of major Federal dredging projects within the Baltimore CE District

In 1974, the District created 6 acres of transplanted *S. alterniflora* by stabilizing the excavated material resulting from the Slaughter Creek, Dorchester County, Maryland, Federal Project.

Since 1975, the Ocean City Inlet and Isle of Wight Bay Federal Project has been maintained by Baltimore District on a regular basis. The excavated material has been placed on the Ocean City beach and on the north end of Assateague Island as a beach nourishment option for erosion protection and beach enhancement. From 1982 through 1987, excavated material from the Federal Project at Knapps Narrows and Claiborne Harbor in Talbot County, Maryland, and Little Wicomico in Northumberland County, Virginia, were utilized as beach nourishment for erosion control. A sand dune was also created at Little Wicomico and was stabilized by planting an acre of *Ammophila* (beach grass) transplants.

In 1982 and 1985, excavated material from the Honga River was used to build and nourish Barren Island at a considerable cost-savings to the District. The habitats established are illustrated in Table 1.

Finally, the NMFS, in cooperation with the CE, will be conducting two beneficial uses demonstration projects in the near future. At the Slaughter Creek, Dorchester County, Project, the excavated material will be used to rehabilitate an existing unproductive oyster bar. The second demonstration will be conducted at the Twitch Cove Federal Project at Smith Island in Somerset County, Maryland. This demonstration will use a sand-filled bag dike in conjunction with the excavated material to create a 3-acre area suitable for *Zostera marina* transplantation.

The beneficial use of excavated material is a vital concept that is economically attractive, that enhances the environment, and that provides an environmentally acceptable disposal option. The Baltimore District will continue to pursue innovative applications of this concept.

Table 1

Barren Island Habitat Development in 1982 and 1985

Habitats	FY 82, acres	FY 85, acres	Total, acres
Ponds	10.0	0.0	10.0
Ditch and tidal flats (mlw) to lower boundary of *Spartina alterniflora*	6.0	0.0	6.0
Spartina alterniflora	16.0	4.0	20.0
Spartina patens	6.0	0.0	6.0
Unvegetated bird nesting sites	4.7	7.4	12.1
Sand/shell least tern nesting area	0.5	0.5	1.0
Total*	43.2	11.9	55.1

* Includes the area exposed at mean low water (mlw) only. Does not include shallow water habitat created below mlw.

HABITAT DEVELOPMENT CASE STUDIES: THE MAINTENANCE OF COLONIAL WATERBIRD DIVERSITY IN THE LONG ISLAND, NEW YORK, REGION: THE RELATIONSHIP OF DREDGING TO SPECIES DISPERSAL AND HABITAT AVAILABILITY

Thomas S. Litwin and David C. MacLean
Seatuck Research Laboratory
Islip, New York

With increasing frequency, colonial waterbirds are becoming an important aspect in the evaluation of Long Island, New York, coastal dredging operations. The relationship between dredging and colonial waterbird survival has grown more acute because available coastal habitat is decreasing at a rapid rate, resulting in regulatory protection of affected species. Simply stated, land use demands are increasing while the available land base is decreasing. Species nesting on Long Island dredged material sites include the roseate tern (*Sterna dougallii*), common tern (*Sterna hirundo*), least tern (*Sterna antillarum*), and piping plover (*Charadrius melodus*).

Using the least tern as an indicator species, the Seatuck Research Program at Cornell Laboratory of Ornithology has been monitoring this species' habitat requirements, nesting success, and regional dispersal patterns since 1982. For the period of 1982-1986, 76 least tern colony sites were identified, 29 (38 percent) of which were dredged material sites. Study site band recoveries for the 1985-1986 seasons suggest regional intercolony movement and dispersal. This is further supported by colony site turnover rates, which ranged between 14 and 29 percent over a 4-year period.

On the assumption that dredging for navigational safety purposes must occur along with colonial waterbird protection, the biology of the least tern can be used to develop an integrated management plan. This plan considers problems associated with short-term habitat loss in relation to long-term habitat gains, the needs for a long-term regional habitat availability evaluation, and the role of dredging as a potential tool for habitat creation in an environment of rapid regional habitat loss.

HABITAT DEVELOPMENT CASE STUDIES: WINDMILL POINT WETLAND HABITAT DEVELOPMENT FIELD SITE, JAMES RIVER, VIRGINIA

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US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

Background

Windmill Point is one of a number of wetland sites built during the Dredged Material Research Program and was begun in 1974. It is a 20-acre dredged material island in the James River, Virginia, located downriver from Hopewell, near Harrison's Bar (Figure 1). It was the first wetland built by the CE for research purposes. This wetland site was selected because it represented a freshwater, intertidal, riverine, Atlantic coast site and had very fine-textured dredged material. The other CE wetlands that were built during the same time period were similarly selected based on their representative geographic and site conditions. These sites have been monitored for up to 13 years, including predisposal, during disposal, postdisposal, throughout habitat development work, and site follow-up phases.

Windmill Point was a cooperative effort. The site was selected by a concensus of the FWS, EPA, NMFS, CE, and the Commonwealth of Virginia. Engineering and physical surveys and island construction were done by Norfolk CE District. WES conducted the long-term environmental site monitoring. In addition to WES in-house research, contracts for site research were awarded to VIMS, Old Dominion University, Environmental Concern Inc., and Soil and Material Engineers Inc.

Island construction at the disposal site was begun in 1974 and completed in 1975. A temporary sand dike was hydraulically placed on the south side of the shipping channel to form a rectangular-shaped island (Figure 2). This material was taken from a sand pocket in the riverbed. In 1975, the island interior was pumped full of fine-textured dredged material from the shipping channel (maintenance material), and the sand dike was breached to allow intertidal flow and the formation of tidal channels in the planned wetland.

A number of technical reports and papers presenting detailed information and data from Windmill Point and its reference areas have been published over several years. These include Adams, Darby, and Young (1978); Boesch et al. (1978); Diaz and Boesch (1978); Environmental Laboratory (1978); Garbisch (1978); Lunz (1978); Lunz et al. (1978); Silberhorn and Barnard (1978); Cheng and Whitehurst (1984); Landin (1984); Newling and Landin (1985); US Army Corps of Engineers (1986); and Landin et al. (in preparation). Readers are referred to these publications for more than an overview on the Windmill Point field site.

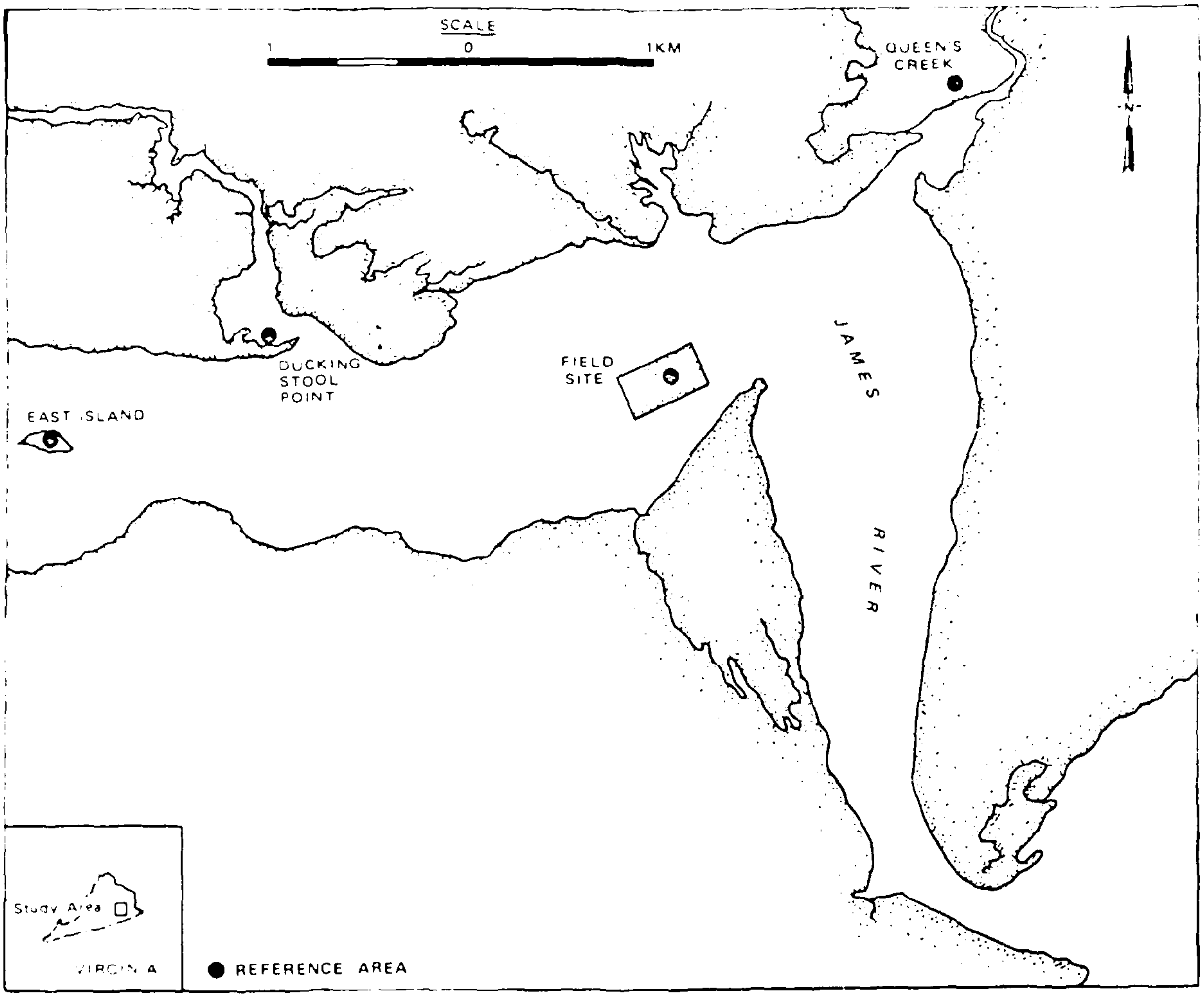

Figure 1. Windmill Point wetland habitat development field site, James River, Virginia

Figure 2. The temporary sand dike that formed Windmill Point, which was filled with fine-textured maintenance material

Figure 3. Freshwater wetland vegetation formed very dense plant communities within 1 year of the island's establishment

Long-Term Monitoring

Prior to island construction, baseline fisheries, wildlife, benthic, sediment, and water quality data were collected. During disposal, water quality was carefully monitored, including the effluent leaving the disposal area. Intensive postdisposal monitoring included soils, vegetation (colonizers and planted species over time), fish and wildlife, benthos, and selected contaminants, and physical island changes such as migration, subsidence, and erosion. Intensive monitoring was conducted through 1978. From 1979 through 1983, monitoring alternated between intensive and low-level efforts each year. Due to limited funding for monitoring, benthos and fisheries monitoring were stopped after 1979, while other parameters continued to be measured.

Between 1974 and 1978, a nearby natural marsh was monitored along with Windmill Point for comparison purposes. From 1979 to the present time, three other natural reference marshes, Queen's Creek, East Island, and Ducking Stool, were monitored and compared with the Windmill Point site (Figure 1).

Vegetation

Originally, development plans called for planting a selected group of herbaceous wetland species on the dike and the interior of the island. However, while plants were being prepared for planting in 1975, the island interior began to rapidly colonize on its own with arrow arum (*Peltandra virginica*), pickrelweed (*Fontederia cordata*), broadleaf arrowhead (*Sagittaria latifolia*), and other freshwater species. By the end of summer 1975, the island interior was densely covered with these species (Figure 3), and no planting was attempted.

The sand dike was planted with several species of grass simply for the purpose of holding the dike in place until the island interior stabilized. No woody plants were used, which, in hindsight, was a flaw in the planting design because river water levels covered the herbaceous vegetation and smothered it. This helped destabilize the dike. Woody plants would have grown to heights above river floods and would have developed more extensive root systems. Therefore, the dike would have remained in place for a longer period of time and helped with island stability.

Permanent vegetation transects were established in Windmill Point and at the reference sites. Randomly selected quadrants along these transects (the same quadrant was never selected twice due to destructive sampling) were sampled for aboveground and belowground biomass, plant height, reproductive stems and heads, percent cover, and species composition. Soil to depths of 12 inches at mlw were also collected. Plant material was washed and oven-dried to determine weights, then ground in a Wiley Mill in preparation for analysis for nutrients and contaminants.

In addition to these permanent transects, plant species lists were maintained chronologically to determine colonization of the island. A total of 75 plant species were found on the island in its first year of life, and the number of colonizers increased each year through 1979, when the plant

species numbers stabilized. Changes in plant communities on the island were fairly rapid. For example, along transects that had originally been primarily arrow arum, broadleaf arrowhead, and pickrelweed on Windmill Point, dense stands of wild rice (*Zizania aquatica*) were found in 1982 covering 60 percent of the site (Figure 4). Prior to that time, pickrelweed had been the dominant species. Erosion and subsidence were constant factors on the island, and by 1985, much of the original transects was gone due to washout of vegetation during river flood stages. Shallow water habitat remained along all the transect lines.

By contrast, on the reference areas, vegetation along permanent transect lines, while comparing favorably with Windmill Point in biomass, remained fairly constant in plant species composition. As the Windmill Point field site was beginning to wash away, the reference sites were still considered stable.

At the present time, the Windmill Point site has broken into two smaller islands, each with vegetation, but very different (Figure 5). The site was attached to a very small existing island when it was first built in 1974, and the woody vegetation on this existing island is still as abundant as it was 13 years ago. The other island has herbaceous wetland plants on it, but the substrate consists primarily of dike remnants and some remaining marsh. Woody vegetation has not colonized this portion of the dredged material site, and it is still subject to erosion.

Wildlife

Since the site was underwater during predisposal monitoring, only occasional birds were sighted at the planned island site. After the site was constructed, over a period of years 85 different species of birds and 4 species of mammals were observed. These included Canada geese feeding on the newly emerging plants when the island was first built, to very heavy waterfowl populations during migration, to bald eagles using the island for perching and feeding. Large numbers of migratory shorebirds were observed each year feeding in the mud flats which formed at the downriver end of the island. Mammals included rice rats, raccoons, muskrats, and mice. Wood ducks were observed using the Ducking Stool and East Island reference sites for night roosts, and this use was not observed at the field site.

More wildlife species diversity and actual numbers were observed at Windmill Point at all times after site construction than at any of the reference sites. This was not unexpected, since Windmill Point was a rapidly evolving island which offered a variety of feeding areas and cover for birds and mammals. By 1984, wildlife numbers were gradually decreasing due to the washout and subsidence of much of the land/emergent marsh area on the island.

Fisheries and Benthos

Fisheries data were collected using a variety of apparatus, including Fyke nets, seines, and traps. Benthos samples were collected in a Ponar grab. Sample sites included both exclosures which excluded feeding shorebirds and

Figure 4. Wild rice was the dominant species at Windmill Point in 1982; prior to that time pickrelweed had dominated

Figure 5. Windmill Point in 1985, showing how the original island has eroded into two smaller islands with larger expanses of shallow water habitat

fishes which would have influenced the sample to determine feeding impact and actual biomass of organisms and unprotected sample stations. Asiatic clams, tubificid worms, and larval chironomids were the dominant organisms found. In 6 months after deposition of dredged material, benthos were found to be at predisposal levels. Meiobenthos were primarily nematodes and small crustaceans. On the reference sites, meiobenthos were more abundant, while the macrobenthos were most abundant at Windmill Point. Fish species found using the field site at various times of the year were largemouth bass, crappie, sunfishes, carp, channel catfish, white perch, striped bass, alewife, blueback herring, and American shad. Fisheries use was found to be approximately the same as at the reference areas throughout sampling. Carp were observed spawning in the island interior in large numbers. Local sportsmen have hunted and fished in and around Windmill Point since its existence.

Contaminants

Five heavy metals (chromium, lead, zinc, cadmium, and nickel) and 14 polychlorinated biphenyls (PCBs) including kepone were examined in soil and plant samples from Windmill Point. While several of these substances were found in the dredged material soil in the island wetland, only DDE was found to translocate to wetland plant shoots. Kepone was found to be relatively stable in the substrate. The only apparent impact from the DDE would be to any wildlife eating shoots of island plants, and from other contaminants, by any wildlife eating roots of these plants.

Summary

The Windmill Point site has been in existence for 13 years. It will not be called a "success" by some, since it has experienced subsidence and erosion after its construction in 1974. However, to the CE, it has been tremendously beneficial and successful in a number of ways: (a) it has developed into a highly productive, rapidly evolving freshwater marsh which survived intact for over 9 years in a high-volume river with strong spring floods and is slowly diminishing in emergent vegetation but increasing in shallow water fisheries habitat; (b) it has provided a demonstration site for use in testing wetland development techniques on dredged material; (c) it has provided a basis for comparison of natural wetlands and man-made wetlands; and (d) it has generated large amounts of hard data that can be used by wetland scientists and engineers in planning future wetland habitat development projects.

In lessons learned, we now know that if we had planted woody vegetation on the sand dike of the island initially, it most likely would have stabilized the dike which protected the marsh interior. We also know that if we had been able to place more material either initially or during a later dredging cycle into the island, it would have helped stabilize the site and nourish the existing wetland.

The intent of long-term monitoring of this and other CE habitat development sites was to determine changes over time and success or failure of sites. No attempt at site management was made. Had the Windmill Point site

been managed by additional applications of dredged material, by repair to the dike, or by other site modifications, it would still be intact as an emergent, freshwater, riverine wetland. Such management by manipulation of dredged material can be incorporated into CE long-term management strategies for dredged material disposal and provides a way to maintain viability of CE habitat development sites in US waterways.

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HABITAT DEVELOPMENT CASE STUDIES: SITING MARSH DEVELOPMENT PROJECTS ON DREDGED MATERIAL IN THE CHESAPEAKE BAY

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Introduction

Nearly two decades of marsh development research has confirmed that marshes can be established in a wide variety of environments (Garbisch 1977, Knutson and Woodhouse 1983). Marshes have been established in tidal elevations from about mean tide level to the estimated highest tide in the Chesapeake Bay. Successful plantings have been made in sediments ranging from fine-grained materials to coarse-grained sands, and in salinity regimes from brackish to salt. A number of publications have summarized planting specifications and guidelines for determining site suitability for the major salt marsh species in the United States (Kadlec and Wentz 1974; Environmental Laboratory 1978; Woodhouse 1979; Sharp, Belcher, and Oyler 1981; and Knutson and Woodhouse 1983).

The most common and persistent foe of tidal marsh development projects is wave attack (Knutson et al. 1981). Planting failure is of particular concern on dredged material marsh development projects. Typically, successful plant establishment on dredged material is necessary to achieve habitat development goals, as well as to prevent the return of material to the dredged channel.

This paper will review the research of Knutson et al. (1981), which provided guidelines for estimating wave climate severity in potential marsh planting sites. In addition, more recent information developed by VIMS (Hardaway et al. 1984) has provided additional information on the subject of evaluating wave severity. Data from the above studies will be used to provide updated criteria for assessing wave severity on potential dredged material disposal sites.

National Survey of Planted Salt Marshes

It is a complex task to describe wave environments in which marsh plantings are likely to survive and thrive. The only method available for determining the growth of wind-generated waves in relatively shallow water is empirical (Coastal Engineering Research Center (CERC) 1984). There are many physical and biological variables which must be acknowledged when attempting to describe the impact of waves on marsh stability. First, the frequency and magnitude of severe wave conditions will be largely influenced by local

climatological patterns, the width (fetch), and water depth. Second, the impact these waves have on the shore will depend on the tidal stage of water level coincident with these waves, as well as such factors as offshore contours, foreshore slope, and shore configuration. Third, the ability of the marsh to withstand wave stress will depend on its growth stage, density, vigor, and overall width.

Faced with a subject of similar complexity, McLachlan (1980) classified beaches in South Africa with respect to wave energy based upon shore characteristics. A similar approach was used by Knutson et al. (1981) in their national survey of planted salt marshes (NSM). Ten shore characteristics were identified as potential indicators of wave severity. A survey was conducted of 86 marsh planting sites in 12 coastal states in order to identify useful indicators.

Four parameters proved to be useful indicators: average fetch, longest fetch, shore geometry, and sediment grain size. The relationship between these parameters and planting success was condensed into a vegetative stabilization site evaluation form (Figure 1). This form is used to evaluate potential marsh planting areas. It allows the user to estimate the success rate of other plantings made under similar conditions.

Vegetative Erosion Control Project

Similar site evaluation studies were initiated at VIMS in 1981 (Hardaway et al. 1984). However, these studies were characterized by greater precision and control and were limited geographically to the tidelands of Virginia in the Chesapeake Bay. The NSM evaluated marshes planted prior to 1980 regardless of planting age, location, or planting method. The vegetative erosion control (VEC) program selected unplanted shore areas that represented a wide range of wave energy conditions. In all, 24 sites were selected. Each of the selected sites was then planted by the VEC staff and evaluated over a 2-yr period.

The VEC program found that straight shorelines with average fetches of about 5 to 10 kilometres are impractical to plant unless some sort of wave protection is provided. It also found that its form (Figure 1) provided a good assessment of site conditions for the purpose of determining the potential success of a planted marsh.

Site Evaluation on Dredged Material Disposal Areas

Because both the NSM and the VEC evaluated only natural shorelines, difficulty is often encountered in applying this information to dredged material disposal areas. Marsh development on dredged material typically requires an appraisal of site suitability prior to the disposal of the material and the creation of a new intertidal shoreline. The predictive parameters of shoreline geometry and sediment grain size cannot be validly applied to potential disposal sites. Shoreline geometry will be modified by the disposal operation

1. SHORE CHARACTERISTICS	2. DESCRIPTIVE CATEGORIES (SCORE WEIGHTED BY PERCENT SUCCESSFUL)				3. WEIGHTED SCORE
a. FETCH-AVERAGE	LESS THAN 1.0 (0.6)	1.1 (0.7) to 3.0 (1.9)	3.1 (1.9) to 9.0 (5.6)	GREATER THAN 9.0 (5.6)	
	(87)	(66)	(44)	(37)	
b. FETCH-LONGEST	LESS THAN 2.0 (1.2)	2.1 (1.3) to 6.0 (3.7)	6.1 (3.8) to 18.0 (11.2)	GREATER THAN 18.0 (11.2)	
	(89)	(67)	(41)	(17)	
c. SHORELINE GEOMETRY	COVE	MEANDER OR STRAIGHT	HEADLAND		
	(85)	(62)	(50)		
d. SEDIMENT[1]	less than 0.4	0.4 – 0.8	greater than 0.8		
	(84)	(41)	(18)		
4. CUMULATIVE SCORE					

5. SCORE INTERPRETATION			
a. CUMULATIVE SCORE	122 – 200	201 – 300	300 – 345
b. POTENTIAL SUCCESS RATE	0 to 30%	30 to 80%	80 to 100%

Figure 1. Vegetative stabilization site evaluation form (from Knutson et al. 1981)

and will continue to change in response to water currents and waves. Sediment grain size will be influenced by the type of material that is deposited and will not be a valid indicator of wave severity at the site.

For coastal engineers, fetch is an important parameter in estimating wave height. The height of a wave formed by a constant wind blowing over water of a constant depth is directly related to fetch length (CERC 1977). This relationship is not linear. For example, a constant wind blowing 50 kilometres per hour over a constant water depth of 6 metres will generate a 15-centimetre wave over a fetch of about 150 metres, and a 30-centimetre wave over 750 metres, a 45-centimetre wave over 2 kilometres, and a 60-centimetre wave over 4 kilometres. As fetch length increases, it has incrementally less influence on wave height. Fetch length is an important indicator of wave severity on a case-by-case basis. The VEC program found excellent agreement between the single parameter of average fetch and the cumulative score on the VEC form for the 24 marsh plantings evaluated. Both average fetch and cumulative score proved to be reliable indicators of planting success.

The "average fetch" parameter appears to be the most useful indicator of potential planting success on planning dredged material areas in the Chesapeake Bay. Table 1 compares "average fetch" and "planting success" in the 43 Chesapeake Bay sites in Virginia and Maryland monitored in the NSM. Sites were categorized as successes (fully or partially successful) only if plant establishment occurred and there was no evidence of erosion landward of the planting area. Table 2 summarizes "average fetch" and "planting success" in the 24 VEC program sites in Virginia. In order to make the VEC program sites comparable with the NSM, "planting success" is defined here as sites in which plant establishment occurred and the backshore (that area between the marsh fringe and base of bank) had not measurably decreased in elevation after the initial planting. Table 3 provides a summary of the results of these two studies.

The NSM success rates are substantially lower than those of the VEC. There are several possible explanations for the apparent discrepancy. First, the NSM sites ranged in age from 2 to 50 years. Knutson et al. (1981) noted that plantings have a functional life and the success rate can be expected to decline over time. Second, the VEC sites were all planted by specialists familiar with marsh planting technology. Third, the NSM criteria for success used here are somewhat more conservative. Elevational profiles were not made on the NSM sites. Therefore, any evidence of erosion, even on the bank in the lee of the marsh, was interpreted as "failure." In many instances, the backshore may have been stable, and the site may have been actively reducing shore erosion despite its "failure" rating.

Conclusions

Sufficient data exist on planted salt marshes in the Chesapeake Bay to permit a valid appraisal of the potential of individual disposal sites to support tidal vegetation. Measurements of "average fetch" alone provide the planner with an important tool for evaluating potential site suitability. The planner must keep in mind that "average fetch" as discussed here is the average distance across open water from the newly created shore to existing shore features. For example, if a dredged material island is sited in the center of the bay 4 kilometres in diameter, any one side of the island will be exposed to an average fetch of only 2 kilometres. Based on the data summarized in this paper, the authors offer the following criteria for evaluating dredged material planting sites in Chesapeake Bay.

a. Average fetch 0.1 to 3.0 kilometres. Dredged material sites within this range have excellent potential for marsh development. Typically, successful establishment and stabilization can be achieved using conventional planting techniques.

b. Average fetch 3.1 to 9.0 kilometres. Sites within this range have good potential for marsh development. Typically, successful establishment and stabilization can be achieved using conventional planting techniques. However, continued maintenance and planting will often be necessary during the first two to three growing seasons in order to produce a fully successful planting.

c. Average fetch greater than 9.0 kilometres. Sites within this range will be difficult to stabilize with marsh vegetation. Plantings will usually require wave protection or the use of specialized plant anchoring techniques during establishment. When siting dredged material areas for the expressed purpose of marsh development, these moderate to high energy areas should be avoided. However, marsh establishment should continue to be considered as an erosion control alternative for these sites. Even specialized high energy planting techniques are an order of magnitude less costly than conventional structural techniques (Allen, Webb, and Shirley 1984; Allen, Shirley, and Webb 1986).

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Table 1

Average Fetch Versus Planting Success (NSM)

Body of Water	Fetch Length, km	Planting Success
Deep Creek, VA	0.1	yes
Wolfsnare Creek, VA	0.1	yes
Lake Rudee, VA	0.1	no*
Lambs Creek, VA	0.1	yes
Mason Creek, VA	0.1	no
Middle Reach South Branch, Elizabeth River, VA	0.1	yes
Sarah Creek, VA	0.1	no
Yeocomico River, VA	0.1	no
Broad Creek, VA	0.1	no
Dymer Creek, VA (I)	0.2	yes
Stutts Creek, VA	0.2	yes
Craddock Creek, VA	0.2	yes
San Domingo Creek, VA (I)	0.3	yes
Lynnhaven River, VA	0.3	yes
Elizabeth River, VA	0.4	yes
San Domingo, VA (II)	0.4	yes
Dymer Creek, VA (II)	0.4	no
Puntoteague Creek, VA	0.5	no
Edgar Cove, MD	0.5	no
Rappahannock River, VA	0.6	no
Onancock Creek, VA	0.6	yes
Woodstock Lake, VA	0.7	yes
Edge Creek, MD (I)	0.7	yes
Cherrystone Inlet, VA (I)	1.0	yes
Edge Creek, MD (II)	1.1	no
Cherrystone Inlet, VA (II)	1.6	yes
Western Branch, Elizabeth River, VA	1.7	yes
James River, VA	1.8	no
San Domingo Creek, MD (III)	1.9	yes
Broad Creek, MD	2.2	yes
Rappahannock River, VA (I)	2.5	no
Slaughter Creek, MD (I)	2.6	no
Harris Creek, MD	2.9	no
Slaughter Creek, MD (II)	3.1	no
Slaughter Creek, MD (III)	3.3	no
Rappahannock River, VA (II)	3.9	no
Tred Avon River, MD (I)	4.7	no
Rappahannock River, VA (III)	4.7	no
Eastern Chesapeake Bay, MD (I)	4.8	no
Tred Avon River, MD (II)	6.5	yes
Eastern Chesapeake Bay, MD (II)	6.7	no
Rappahannock River, VA (IV)	9.3	no

* A "failure" rating gives only an indication of edge erosion, and many such sites had vegetated in their backshore areas.

Table 2

Average Fetch Versus Planting Success (VEC)

Body of Water	Fetch Length, km	Planting Success
Crystal Lake, VA	0.1	yes
Tabbs Creek, VA	0.1	yes
Pamunkey River, VA	0.6	yes
Corrotoman River, VA	1.1	yes
Occohannock Creek, VA (I)	1.3	yes
Broad Bay, VA	1.5	yes
Piankatank River, VA	1.6	yes
Milford Haven, VA	1.9	yes
Rappahannock River, VA (I)	2.7	yes
York River, VA (I)	2.8	yes
Rappahannock River, VA (II)	3.0	no*
York River, VA (II)	3.7	no
Rappahannock River, VA (III)	4.3	yes
James River, VA (I)	5.6	yes
James River, VA (II)	5.7	yes
James River, VA (III)	5.9	no
Rappahannock River, VA (IV)	6.5	yes
James River, VA (IV)	9.5	yes
James River, VA (V)	10.6	no
Occochannock Creek, VA (II)	20.4	no
Rappahannock River, VA (V)	24.8	no
Potomac River, VA	27.8	no
Mobjack Bay, VA	28.9	no
Chesapeake Bay, VA	40.7	no

* A "failure" rating gives only an indication of edge erosion, and many such sites had vegetated in their backshore areas.

Table 3

Average Fetch Versus Planting Success

Average Fetch, km	Success Rate (NSM), %	Success Rate (VEC), %
0.1-3.0	55	90
3.1-9.0	13	67
9.1 or greater	0	14

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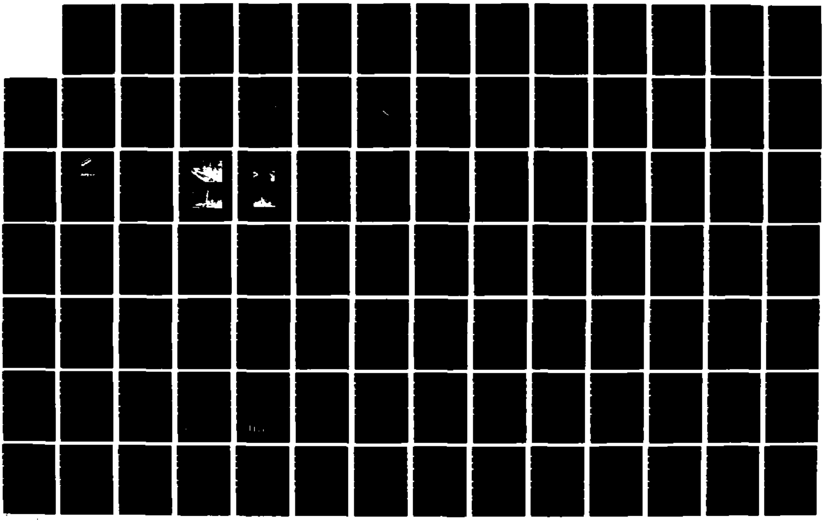

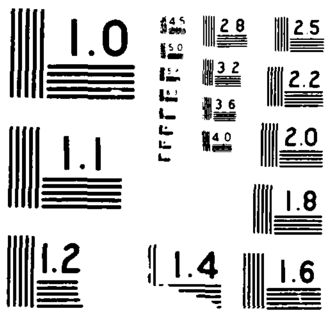
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QUESTION: What are the impacts of ice and winter storms on sand bags where you are planting eelgrass?

MR. EARHART: If the entire water column was to freeze, there may be impacts on the sand bags. However, the bags are in 4 feet of water; I should point out that the bags are meant to be temporary structures only useful until the eelgrass beds become established. They were placed to dissipate wave energy. With an epoxy coating, the manufacturer's 7-yr life span guarantee would double. However, our need for the structure is to act as a wave dissipater through one growing season.

QUESTION: What problem factors and aquatic species do you anticipate in these eelgrass areas?

MR. EARHART: On Smith Island's east coast, there is predominantly eelgrass already growing along the shorelines. Our test site was located there because eelgrass is located in the area. We thought other possible sites might not do well because they did not already have some eelgrass present due to some unknown factor such as strong wave energy or water depth. Site selection was based on minimizing these two potential problems. The remaining dredged material was used to decrease water depths as an additional wave buffer. Softshell crabs are common in this area and are frequently found associated with eelgrass beds. We will be making comparisons between use of the new beds and existing beds.

QUESTION: Will the CE manage such sites as Barren Island?

MR. EARHART: Barren Island has been turned over to the State of Maryland for use as a wildlife management area to do with as they see fit.

QUESTION: The State doesn't have manpower or funds to manage these sites, and it should be the CE's responsibility.

COL WALSH: The realities of Baltimore District maintaining Barren Island were never there, except by new applications of maintenance dredged material. Means are there for island/marsh nourishment using dredged material applications. It would be better if the CE or your agency had funds to manage the dredged material sites, but that unfortunately is not the case. We do the best we can.

QUESTION: Do you have criteria for analyzing dredged material for beach nourishment? What happens if the material is silt?

MR. EARHART: Normally, we like to use predominantly sand. We had an experimental project that was not just sand. We also tried a new technique using perforated pipe, similar to that used in the Carolinas for dune formation. It worked well for temporary erosion control.

QUESTION: What do you mean by temporary?

MR. EARHART: The deposits placed in February are still in place in May, but one storm could take them away. We did provide some temporary relief to erosion, which was our only intention in that project.

QUESTION: What are the factors for marsh establishment based on sediment size?

MS. STEELE: The impacts of sediment size on marsh establishment were analyzed in our national survey, and those criteria were used to determine the type of marsh, and its relative stability, that could be built.

QUESTION: With the problems associated with dredged material, has the CE initiated any creative investigations in intercepting sediment before it gets in the channel?

MR. EARHART: We have several breakwater and jetty projects under way to intercept sediment to prevent it going back into the channel and to help stabilizing behind the jetty. We built a revetment at Black Walnut Harbor, and we have responsibility for numerous sediment control structures throughout the District.

COL WALSH: One project in place on the Eastern Shore was built to slow maintenance dredging, and it did this very effectively. A breakwater was built, and this is much less expensive over the long haul than continuous maintenance dredging.

MR. MERRILL: A two-phase study in Chesapeake Bay on the effects of shoreline erosion looked at siltation into channels and effects on aquatic resources.

MR. NOEL BEEGLE: Norfolk and Baltimore Districts are working on this in Chesapeake Bay. The State of Maryland and the CE signed an agreement on 11 May 1987 to proceed from Phase I (reconnaisance) to Phase II, which is feasibility. This includes site-specific investigations of critical shoreline areas in the Bay and monitoring/modeling sites for aquatic resources. Cost-effectiveness is important. At one area at Smith Island, dredged material was placed, and native vegetation was used to solve erosion problems and to create habitat. The Commonwealth of Virginia and the CE agreement is very close to signature at the present time, and similar studies will take place in Virginia Chesapeake Bay waters. This is a multi-year, multimillion dollar initiative, and we are very excited about its potential for restoring the bay.

COMMENT: In discussing ways to minimize sediment--the Navy keeps sediment from settling in its submarine harbors on the west coast by using water jets to keep material in suspension and to maintain proper depths without dredging.

QUESTION: It's easy to see many uses when you are dredging sand, but what about silt? We have major problems in small marinas that have silted in.

DR. LANDIN: Silt is an appropriate substrate for marshes because it is so nutrient-enriched. Growth can be phenomenal on silty sites. However, it causes stabilization problems, and silt is nearly always coupled with some kind of temporary retention structure or breakwater to keep dredged material in place long enough for vegetation to establish.

QUESTION: Habitat development has basically been our topic today. The CE has a prominent role in this, but what kind of interagency coordination is required to do this type of project? What does it take to get these projects off the ground? Do you form an interagency task force?

MR. EARHART: We form special advisory committees. The District is interested in long-term disposal options. A committee consists of Federal, State, and local representatives and meets three to four times a year early on, then as needed later. The committee on the Honga River will meet in September 1987. As far as shellfish, seagrasses, and other aquatic habitats are concerned, we have a working group of NMFS, EPA, the State of Maryland, and others to meet and discuss strategies. Beach nourishment is handled through normal NEPA review and coordination processes.

MR. MERRILL: This underscores the new status of water resources. With cost-sharing by local sponsors, it is very important to get their input. Since they will be paying a share of the work, they need to have such input and to be represented on working groups and committees.

BEACH NOURISHMENT AND SHORELINE STABILIZATION: OPENING REMARKS

Thomas N. Yancey, Jr., Moderator
US Army Corps of Engineers
Norfolk, Virginia

I would like to welcome you to our session. Some of the most popular beneficial uses of dredged material are beach nourishment, shoreline stabliza-tion, and erosion control. There is a good reason for this popularity. I don't think I have to convince any of you that there are major problems along our east coast shorelines and beaches with erosion.

Many communities are faced with beach and property loss, with a resulting loss of income each year. This problem is continuous, and many communities are desperate for solutions. In Hampton Roads, Virginia, for example, there are many miles of beaches that are susceptible to the forces of nature. With the construction of the Baltimore and Norfolk Harbors channel deepening projects, millions of cubic yards are being removed. The prospects of using this material for beach nourishment has generated a tremendous amount of interest. I am sure that other areas along the east coast will also be examining use of such material for beach nourishment and shoreline stabilization. It makes good sense to use this material beneficially and to take advantage of material from dredging projects.

Today we have three excellent speakers on these subject areas. First is my good friend Sam McGee, a civil engineer with Norfolk District. He was Project Manager during the design of the 50-foot channel project in the Dredging Management Branch. He has been with the CE since 1978.

Our second speaker is Bill Slezak, who has worked in the New York District since 1976. He is Chief of the Navigation Branch there, and his specialty areas include ocean dumping, dredging, beneficial uses of dredged material, wetlands protection, and underwater berms.

Our final speaker is Hollis Allen from WES, who is leader of the Habitat Resources Team in the Environmental Laboratory. Hollis has worked in developing and applying biostabilization techniques in wetlands on the gulf and South Atlantic coasts for a number of years. His primary expertise lies in habitat development and shoreline stabilization. He has been with the CE at WES since 1969.

BEACH NOURISHMENT AND SHORELINE STABILIZATION: THE USE OF DREDGED MATERIAL FROM THE HAMPTON ROADS DEEPENING PROJECT

Samuel E. McGee
US Army Corps of Engineers
Norfolk, Virginia

Introduction

The construction of the 55-foot channel for Hampton Roads will ultimately require the removal of approximately 60 MCY of dredged material, and the construction of the Virginia portion of the 50-foot channel to Baltimore will require dredging approximately 25 MCY (Figure 1). Substantial quantities of dredged material, suitable for beach nourishment and construction fill, will be excavated during construction of these projects. In accordance with applicable laws and Federal policies, the beneficial use of dredged material was thoroughly investigated during the preparation of the General Design Memorandum (GDM) for the Norfolk Harbor and Channels Deepening. These design investigations confirmed that substantial quantities of beach quality sand would be removed from the channels during some phases of construction, and that beach areas were located within navigation project areas which appeared to be suitable candidates for beach nourishment. Other beneficial uses for the dredged material that were also evaluated included construction fill for the island construction phase of the I-664 Hampton Roads Crossing, other construction and fill work, perimeter dike stabilization for the Craney Island Federal Disposal Area, and the construction of an offshore underwater berm in the Atlantic Ocean.

During the engineering and design of the Norfolk Harbor and Channels project, the Commonwealth of Virginia was advised of the opportunity presented by the anticipated excavation of large quantities of good quality material and advised as to the procedures and State requirements that would have to be accomplished in order to realize the benefits from this opportunity. Favorable responses from the Commonwealth and several local governments resulted in the development of preliminary beach fill plans for beach sites along the lower Chesapeake Bay and the Atlantic Ocean. These preliminary plans addressed the quality, quantity, and recoverability of the dredged material and evaluated the compatibility of the dredged material with the native material on the beaches. Comparative cost estimates were developed which provided a means for analyzing the expected cost change attributable to the beneficial use of the material when compared with the primary disposal plan. This information was intended to provide a rational basis for the Commonwealth and interested local governments to make the necessary policy and funding decisions required for the actual implementation of the beneficial use of the material.

The implementation of a successful beach fill plan or other beneficial use of dredged material requires the resolution of many complex issues involving lands, easements, utilities, local cooperation agreements, funding

agreements, and environmental protection. It should be emphasized that the successful resolution of these issues requires comprehensive and accurate engineering and design information. There is no substitute for accurate information regarding the location, type, quantity, and recoverability of the material to be dredged. Similarly, the specific beach area to be filled must be thoroughly investigated and incorporated into the construction plan for the parent navigation project. The beneficial use of dredged material for beach nourishment depends on the development of a practical, economical, and environmentally acceptable construction plan which results in the use of dredged material being more cost-effective than alternative sources of material for beach fill.

Policy Issues

Although the primary function of navigation project construction and maintenance is to provide safe and efficient waterways, Congress has also directed that the dredged material from such projects be made available to the states for placement on state beaches. The basis for Federal policy is the WRDA of 1976 (PL 94-587). Section 145 of that Act states, "The Secretary of the Army acting through the Chief of Engineers, is authorized upon request of the state, to place on the beaches of such state beach quality sand which has been dredged in constructing and maintaining navigation inlets and channels adjacent to such beaches, if the Secretary deems such action to be in the public interest and upon payment of the increased cost thereof above the cost required for alternative methods of disposing of such sand." The above language was modifed by the WRDA of 1986 (PL 99-662) to insert after the word "payment" the words "by such state of 50 percent".

Several key words have been underlined which merit further discussion. It is important to note that action on this beneficial use of dredged material usually will require a "request from the state." This would imply that a local government wishing to use dredged sand under the provisions of this law must first obtain the concurrence and sponsorship of the State. This is in fact the District position that has been submitted to the Commonwealth of Virginia. This policy enables the Commonwealth to resolve conflicting local government requests for sand and establish State priorities before requesting Federal assistance. The requirement that the dredged material be "beach quality sand" places the responsibility on the CE to determine the character of the material to be dredged and its suitability for beach nourishment. The material is normally evaluated in accordance with the engineering and design procedures for beach nourishment contained in the Shore Protection Manual (US Army Corps of Engineers 1984a).

The CE must also evaluate the location of the dredging with respect to the reasonable definition of being "adjacent" to the navigation project. If the above criteria are met, then the CE must also make a general evaluation of the project to determine if it is in the "public interest." This public interest determination may be complicated by uncertainties regarding the ownership of the beach or determining the expected benefits to be derived from the beach nourishment. With regard to establishing the "increased

cost" for placing sand on the beach above the cost for alternative methods, the CE must perform the necessary cost engineering studies to accurately estimate such cost. Other pertinent policy information may be found in CE publications (US Army Corps of Engineers 1981a, 1983a, 1983b).

Subsequent to a thorough policy review for the Hampton Roads deepening, the Norfolk District conveyed a summary of the beach disposal policy to the Commonwealth and interested local governments. The Commonwealth in turn has developed State policies and procedures and provided guidance to the local governments.

Many of these so-called "policy issues" are in fact fundamental engineering questions. These items include the quality of the material and its compatibility for beach fill and the issue of the beach being "adjacent to the channel." Lastly, the question of the increased cost can be answered only after adequate engineering and cost analysis of the alternatives. The successful use of a dredged material for beach fill depends upon the willingness and ability of the Federal and State officials to develop a suitable plan in conformance with the appropriate policies and laws.

Engineering and Design Objectives

The resolution of many of the policy, real estate, and environmental issues depends upon comprehensive and accurate engineering and design. A primary engineering objective for the construction of channels and the design of beach fill projects is the collection of adequate soil information from the dredging area as well as the beach. If beach nourishment is incorporated into a dredging project, it is likely that a more comprehensive subsurface investigation plan for the channel will be required than if dredging were the only consideration. Sufficient borings must be made and analyzed to develop a clear picture of the vertical and horizontal limit of the sand deposits in the dredging area. Beach investigations must determine the characteristics of the native material, the location of utilities, structures, outfall pipes, property lines, long-shore sediment transport, and other basic engineering data. This information must, in turn, be analyzed to determine such items as the acceptable grain-size range of the material, the design berm height, width, and length, the probable fate of the material, expected loss rates, and the resulting maintenance requirements.

The ability to meet the desired engineering objectives will generally be constrained by the engineering and design budget and by the project construction schedule. The engineering and design studies for the Hampton Roads project were favored by an adequate design budget and schedule. For this reason, the engineering efforts on behalf of the beach nourishment alternatives represent an optimum approach to achieving the engineering objectives. Engineering and design work was governed by the engineering criteria set forth in ER 1110-2-1484 (US Army Corps of Engineers 1981b)and EM 1110-2-1613 (US Army Corps of Engineers 1983c). The District was also able to conduct a very comprehensive soil investigation program which used soil borings (Figure 2), seismic profiling and laboratory testing to develop

both the vertical and horizontal extent of sand deposits (Figures 3-4). A full geotechnical report appendix (in five volumes) for the final GDM (US Army Corps of Engineers 1986a) was prepared and later used as part of the actual contract documents.

As comprehensive as this soil information is, the actual implementation of a beach project may require supplemental investigations depending upon the type and scope of beach projects that may be developed by the Commonwealth. These investigations were further supported by specific field investigations of the candidate beach areas, hydrographic surveys essential for determining quantities, and analysis of the available construction plant and methods.

Specific engineering and design studies for the candidate beach sites were accomplished by contract, and individual reports for each beach alternative were prepared (US Army Corps of Engineers 1984b, 1984c, 1984d, 1986b, 1986c). The purpose of these reports was to evaluate the use of dredged material from a specific channel to nourish a specific beach area, in accordance with the general guidance contained in the Shore Protection Manual. These reports used a beach fill "scenario" representative of an optimum beach nourishment project for the particular beach. These reports, while not providing specific designs, do provide the kind of information needed by the State and local officials to compare alternatives. The beach nourishment reports were further supplemented by a cost engineering report (US Army Corps of Engineers 1986d) which provided an analysis of construction equipment, methods, relative costs for the various beach disposal alternatives when compared with the primary ocean disposal plan construction cost. These investigations were aided by previous local beach nourishment projects which used dredged material and by Murden (1978) and the US Army Corps of Engineers (1976, 1981c, 1981d).

A major engineering objective that must be achieved is the determination of how much of the available sand can actually be recovered using standard dredging practices and contract specifications. Dredging is primarily for producing an acceptable navigation channel, not for mining a particular deposit of sandy material. In other words, the recovery of the sand deposits must be designed in conformance with the channel construction specifications. Acceptance sections or dredging areas must be selected to result in maximum sand recovery but still be consistent with normal channel dredging practices whenever possible. The use of special dredging equipment requirements or recovery specifications could have an adverse impact on the total channel dredging costs and should be avoided. This is particularly important if the navigation channel produces very high benefits and the benefits of beach nourishment are marginal.

Real Estate Issues

The inclusion of a beach fill disposal alternative in a Federal construction contract requires that all necessary easements and rights-of-way needed for construction be conveyed to the Federal government. This can become a complex and difficult task due to the often uncertain issue of property lines and rights along the coast. These requirements must be identified and addressed in appropriate local cooperation agreements. The determination of property interest may also influence the overall assessment

of the "public interest" of the beach fill alternative. If the eroding beach is held by private interest, it may preclude the use of State or Federal funds for the nourishment of the beach. Because of the length of time that may be required to resolve these real estate matters, close coordination and information exchange between the engineering and real estate staffs are necessary if construction schedules are to be met. In summary, beach areas which are unquestionably "public beaches" and have previous histories of beach nourishment are ideal candidates for inclusion in the navigation channel construction contract, whereas "private beaches" may present problems which cannot be resolved within the available time.

Environmental Issues

The use of dredged material for beach nourishment has been a common practice for many years and in most cases has resulted in little discernible environmental impact to the coastal environment. The general lack of adverse impacts reflects the adaptability and resilience of the resident species which have adapted themselves to the dynamic beach environment. In some cases, however, the beach environment may not be fully compatible with a beach fill project due to the existence of nearby sensitive coral reef structures or the nesting habits of sea turtles or seabirds. The highly developed shoreline of the lower Chesapeake Bay is generally free of these environmental concerns and has routinely used beach fill from both upland borrow sources and dredged material with no apparent adverse impacts.

If specific environmental protection or mitigation measures are applied to the use of the channel material for beach nourishment, the project constructability must be carefully evaluated. Specific time restrictions or limitations on the type of construction equipment or procedures may preclude the inclusion of beach nourishment in the channel dredging contracts. In most cases, this can be avoided if the environmental studies and engineering design are accomplished concurrently and is fully coordinated.

The use of dredged material for beach nourishment should be engineered in a manner which results in the least environmental impact while still providing an efficient and cost-effective construction plan. If this is not done, the demands of the navigation project construction schedule will override the desire to use the dredged material in a beneficial manner.

Funding Requirements

PL 94-587 and 99-662 require the State to provide 50 percent of the increased costs associated with the use of dredged material for beach nourishment. The State, in turn, may require the local governments with beaches to participate in the funding. The added cost for beach nourishment normally results from the need for additional plant and equipment and the additional construction time required for transporting material to the beach.

Adequate cost engineering is necessary at a point in time which allows both the Federal and State budget process requirements to be met. Sufficient funds must be budgeted for the construction year to permit the beach nourishment work to be included in the channel dredging contract. The cost engineering and analysis must compare the least cost approved disposal plan with the estimated costs for the beach disposal plan. It is the increased cost which must be shared in accordance with the applicable laws.

The cost-sharing must be provided for in an appropiate funding agreement between the State and Federal government. These agreements must be consumated before the work can be advertised in accordance with normal procurement practices.

Project Execution

The actual execution of the use of dredged sand for beach nourishment is accomplished as an integral part of the channel dredging contract. As a part of the Federal dredging contract, routine CE contract supervision and administration are used.

It is the successful resolution of the policy, engineering, real estate, environmental, and funding issues which allows project execution. Failure to adequately resolve any of these issues will probably result in the loss of the opportunity to use the dredged material in a beneficial manner.

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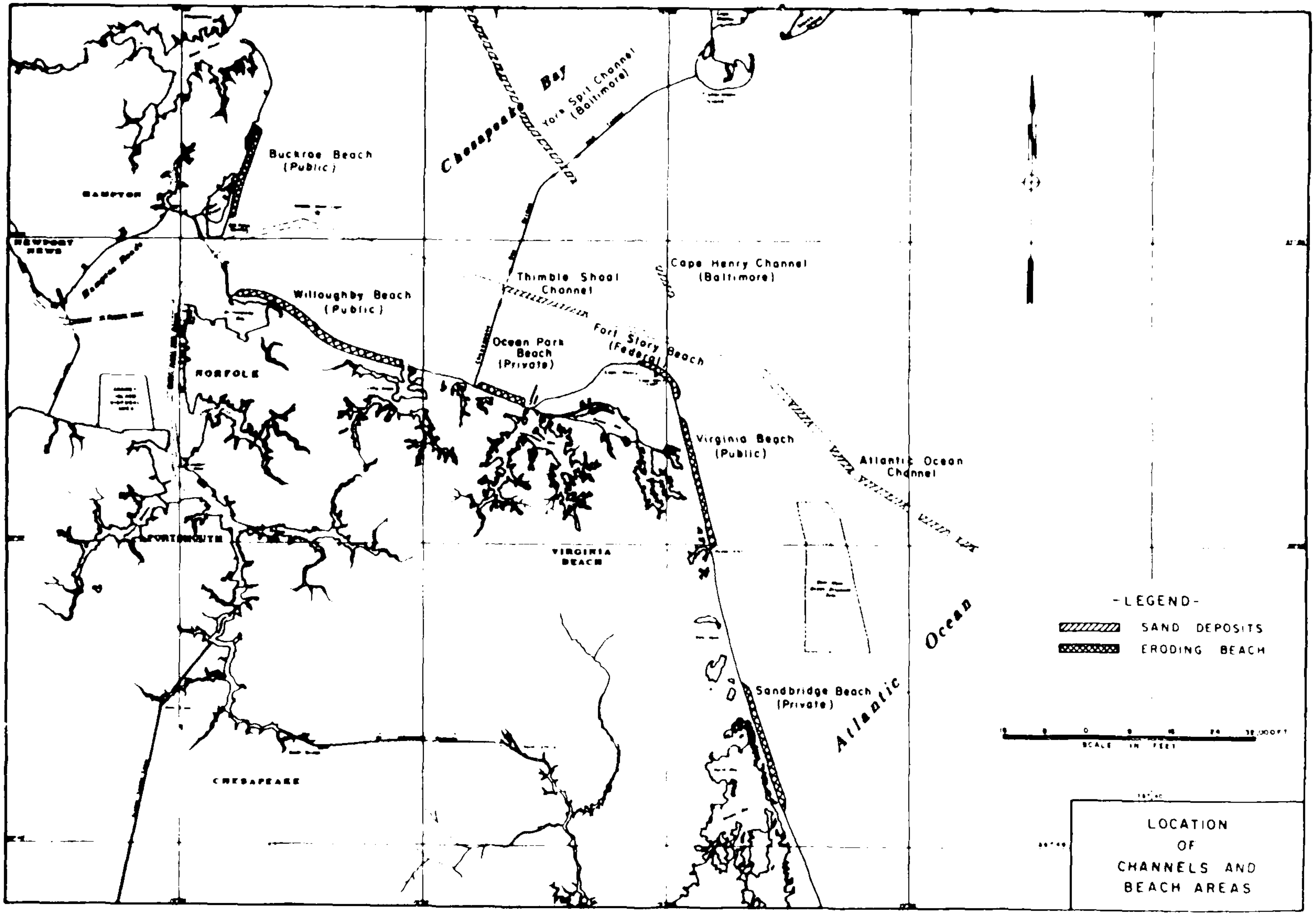

Figure 1. Location of channels and beach areas

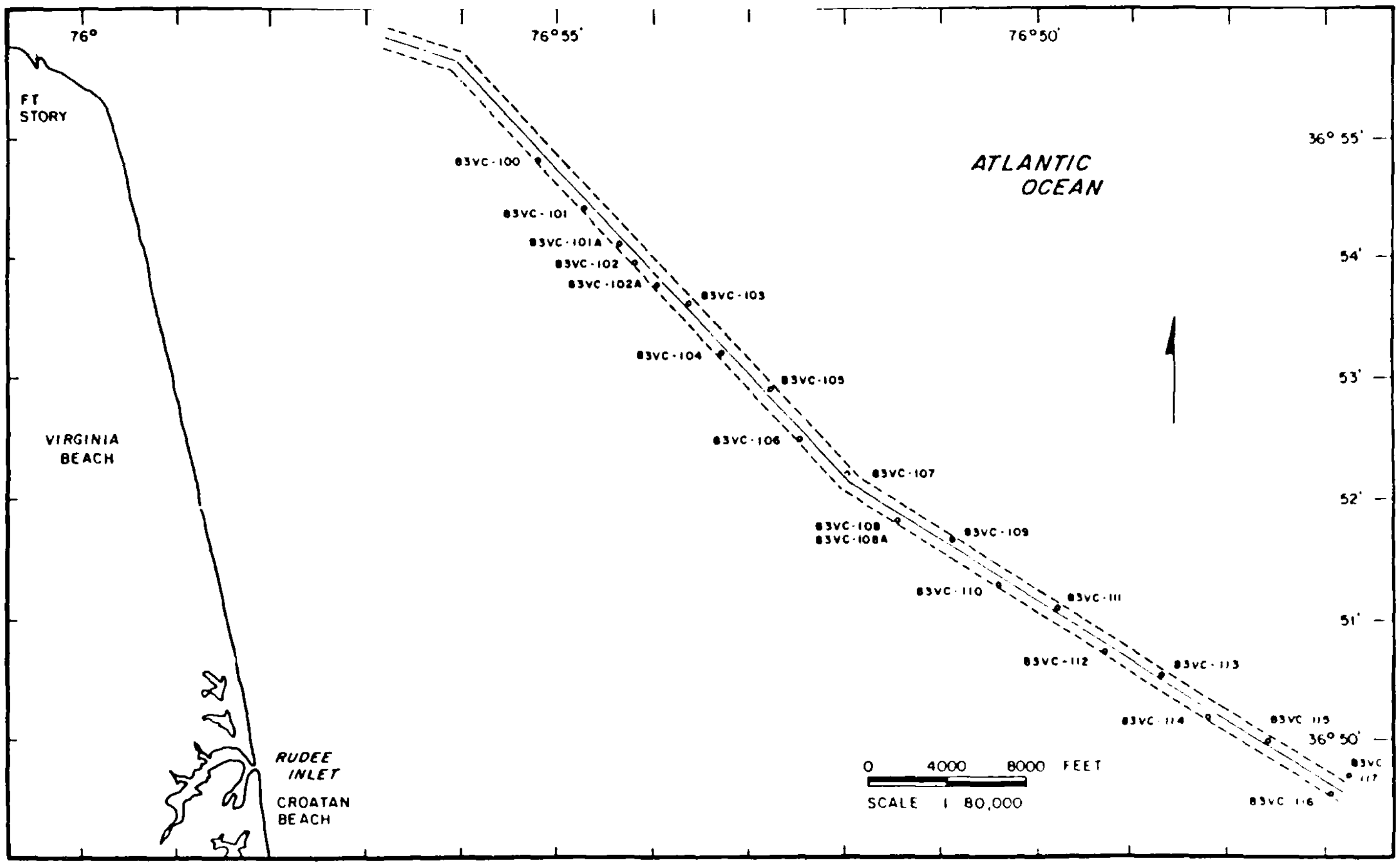

Figure 2. CE core locations for sediment samples of the Atlantic Ocean channel

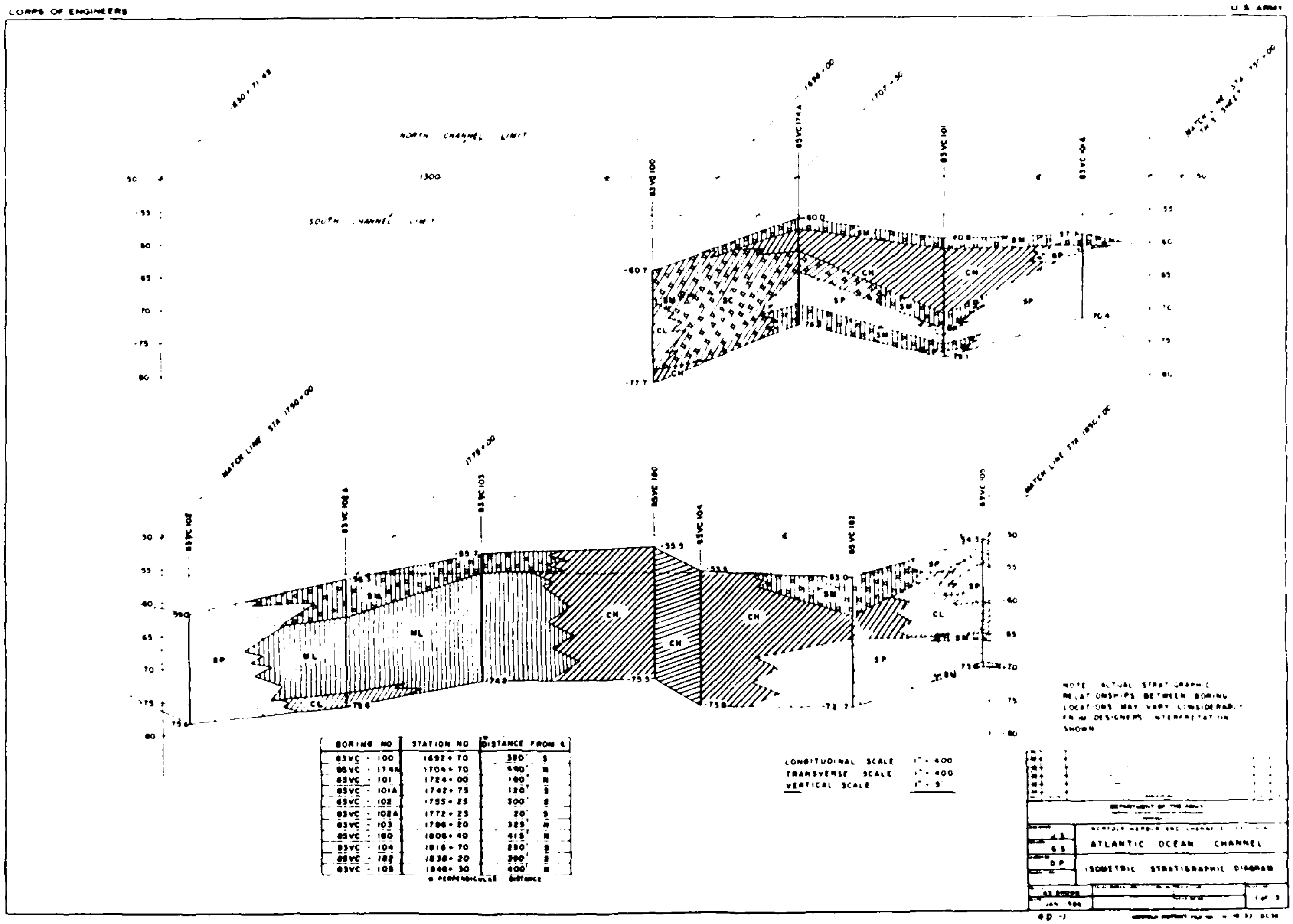

Figure 3. Isometric stratigraphic diagram of the Atlantic Ocean channel (Sheet 1 of 3)

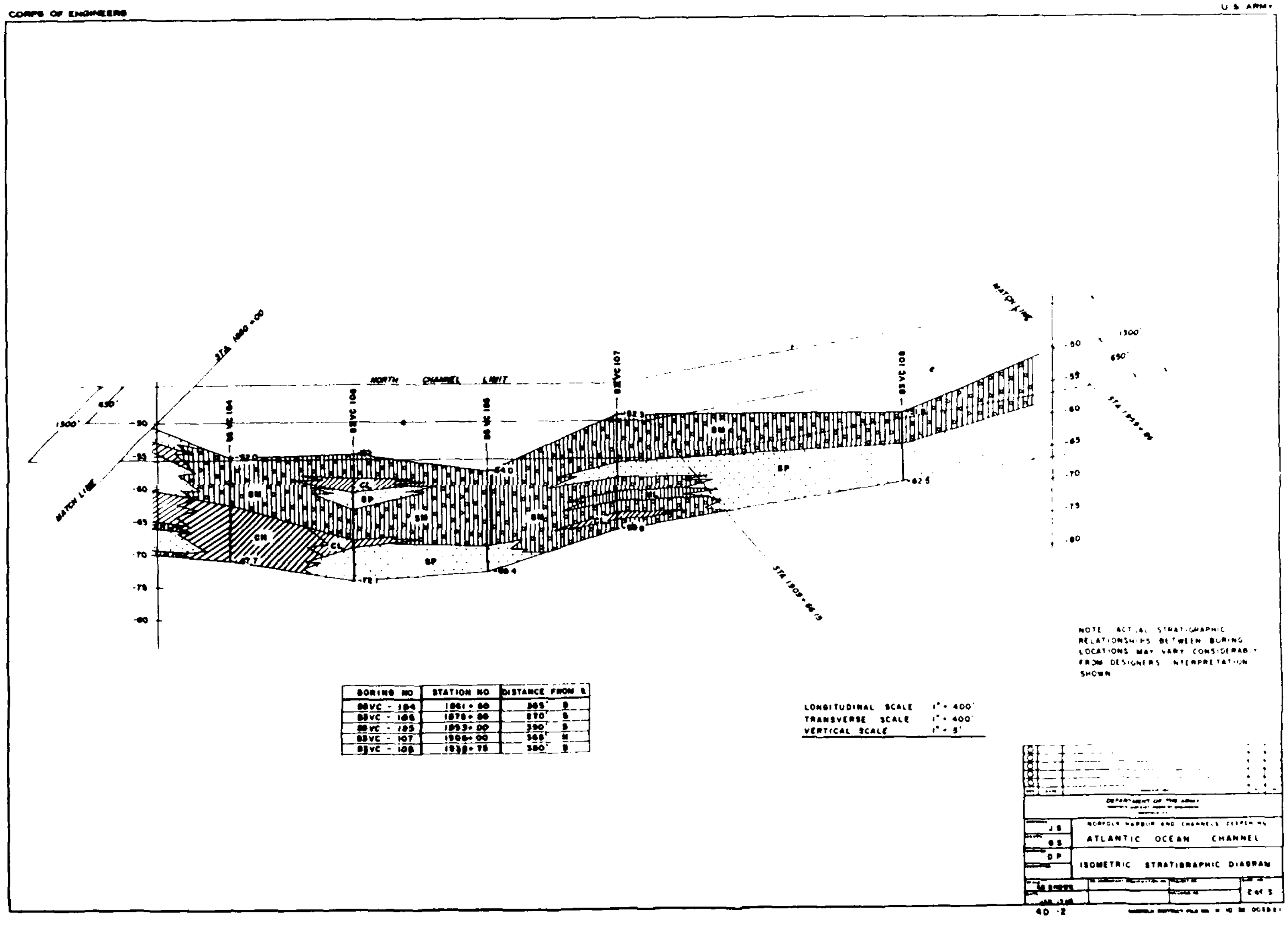

Figure 3. (Sheet 2 of 3)

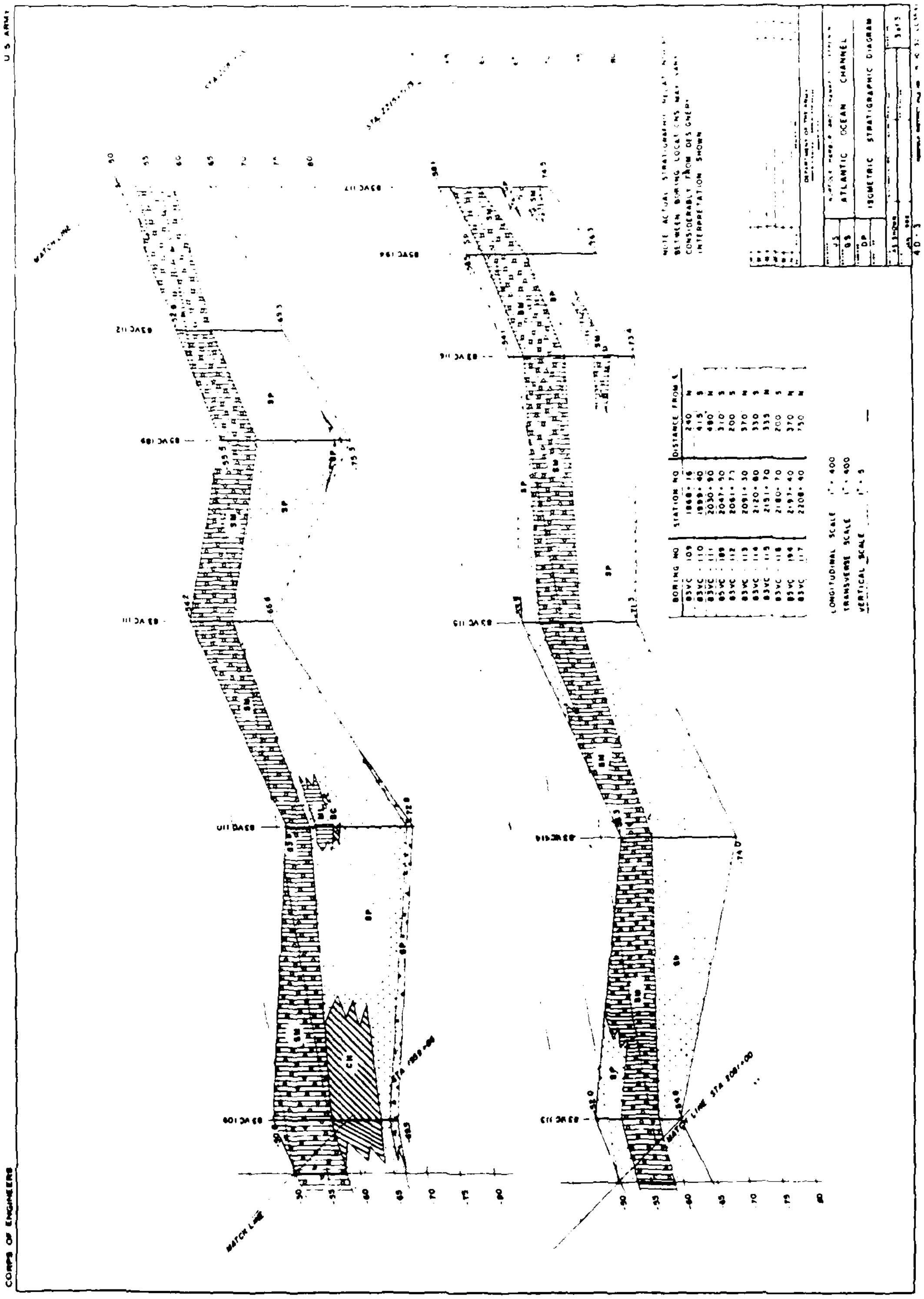

Figure 3. (Sheet 3 of 3)

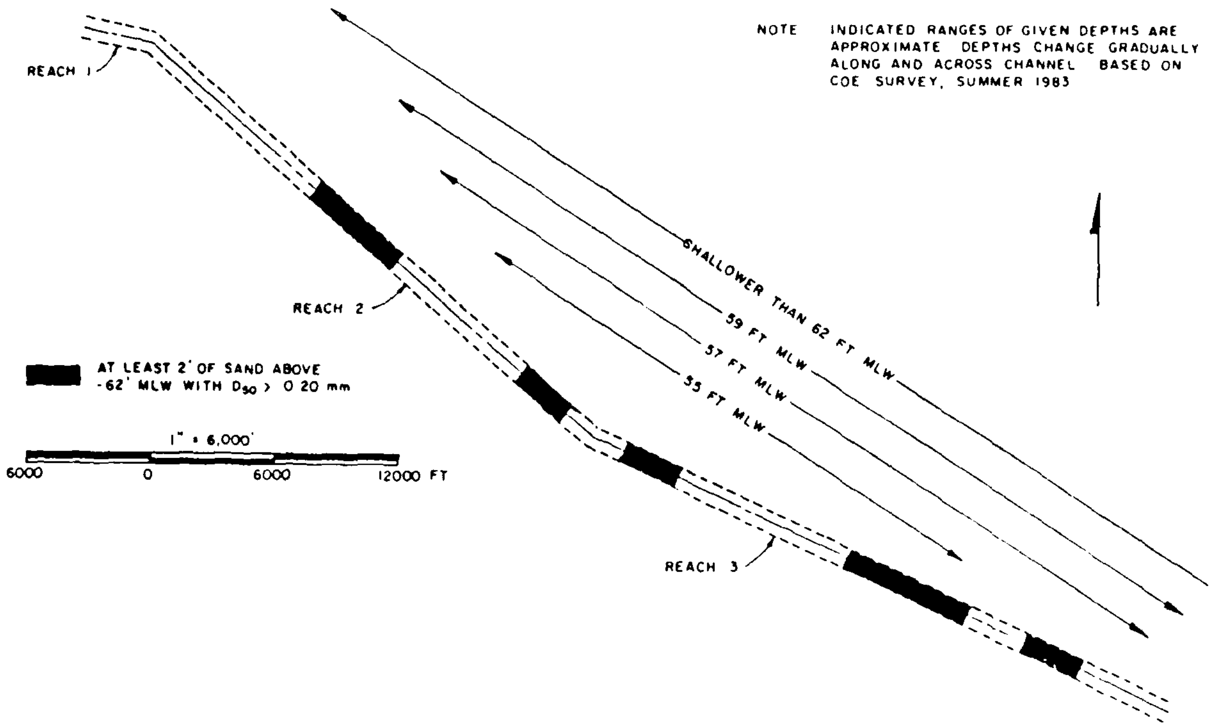

Figure 4. Sand at dredging depths in the Atlantic Ocean channel

BEACH NOURISHMENT AND SHORELINE STABILIZATION: AMBROSE CHANNEL DREDGING---EVERYONE WINS

William F. Slezak
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Introduction

I plan to talk about several examples of productive uses of dredged material from Ambrose Channel. Since this presentation is being given during a session on beach nourishment, I will focus on a beach nourishment project undertaken a few years ago that utilized dredged sands from Ambrose Channel. However, I also plan to briefly discuss some other productive uses that have been made of Ambrose Channel sands.

Ambrose Channel is the main entrance channel into the Port of New York. It is 2,000 feet wide, with an authorized depth of 45 feet below mlw, from deep water in the Atlantic Ocean to deep water just south of the Narrows (Figure 1).

Construction of Ambrose Channel was originally authorized in 1899 for a 40-foot channel, 2,000 feet wide through an offshore sand bar averaging about 16 feet in depth. The channel was sufficiently deepened by 1907 to permit the LUSITANIA to pass through and enter New York Harbor. This was an enormous achievement and represented one of the largest civil works projects authorized by Congress to that date. Deepening to 45 feet took place in the 1950s.

Maintenance dredging within Ambrose Channel has historically been required about every 1 to 2 years with an average of 0.4 MCY of material removed each year. The materials dredged are largely fine-to-medium sands which originate from the longshore littoral transport along the south shore of Long Island. Historically, this material has been disposed of at a designated dredged material site known as the "Mud Dump," which is located several miles to the south of the entrance to Ambrose Channel.

Beach Nourishment at Sandy Hook

About 5 miles to the southwest of Ambrose Channel is located a sand spit known as Sandy Hook, which forms the southern exposure to Lower New York Harbor. Sandy Hook is presently part of the Gateway National Recreation Area, a national urban park serving the New York Metropolitan Area. This park with its bathing beaches is heavily utilized for recreation, with over 2 million visitors each year.

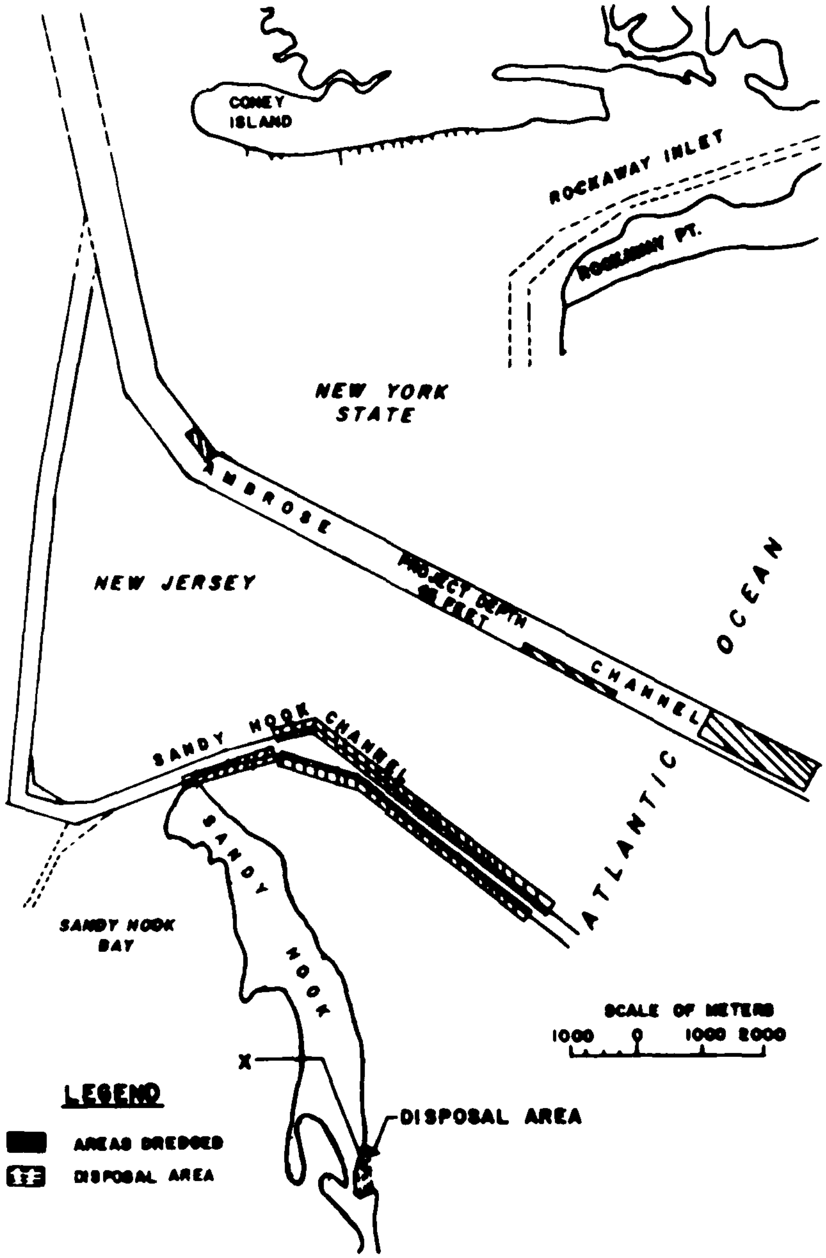

Figure 1. Project sites in New York Harbor. The dredged material sites are depicted by lined boxes with "x" marking the off-loading site and the associated pipeline route to the disposal area

Within the park is the northern terminus of a seawall-groin system which was constructed along much of the northern New Jersey coast in an attempt to stabilize the shoreline. Since completion of the seawall in the early 1950s, the area to the north has undergone serious erosion due to the elimination of the predominant northerly flow of sand by the seawall-groin system. This area was characterized as a critical zone because of the threat of access interdiction (Sherman et al. 1977).

An Environmental Assessment prepared by the National Park Service (NPS) in 1978 recommended placement of two MCY of sand in the area. However, lack of funding precluded this work from being accomplished. By 1981, continued erosion led to the loss of two lanes of the four-lane access road during a November northeaster.

In early 1982, discussions began between the CE and the NPS concerning the possible use of dredged material from Ambrose Channel, which was scheduled for maintenance dredging later that year, as nourishment for the critical zone area of the beach. Earlier attempts to utilize dredged sands for nourishment purposes had failed because of lack of NPS funds to pay the increased cost for placing the material on the beach. PL 97-257 provided a supplementary appropriation and directed the NPS, utilizing the CE, to begin providing hydraulic fill to the Sandy Hook area.

Shortly thereafter, bids were solicited and a contract was awarded for the first phase of the beach reconstruction, which involved dredging one MCY from Ambrose Channel with placement on the critical zone of Sandy Hook. Just prior to mobilization, another northeastern storm washed out the remaining two lanes of the access road. A temporary road had to be constructed to allow access to the northern part of Sandy Hook.

Dredging and Beach Placement Operation

The first phase of work was initiated 5 November 1982 and was designed to prevent any further erosion in the critical zone area from the expected winter storms. The beach was to be built up hydraulically in the critical zone to an elevation of 8.2 feet and extended seaward a distance of about 800 feet from the access road. Hydraulic placement enables the fines to be winnowed out and results in maximum compaction. The final seaward slope of the sand fill below 5 feet was to be the uncontrolled hydraulic slope of the material placed as a result of natural forces.

The dredge utilized for this operation was the hooper barge LONG ISLAND which is the largest such dredge in the world with the capability of hauling up to 15,000 cubic yards of sand. The LONG ISLAND also has pumpout capability. It is not self-propelled and must be pushed by a tug which fits into a notch in the stern. Fully loaded, the dredge draws 27 feet, while empty it draws 7 feet.

With winter approaching, the decision was made to locate the pumpout site to within the relatively protected waters of Sandy Hook Bay, where the controlling depths were about 20 feet at mlw. Tide levels were measured

with an electronic tide gage which gave continuous tide readings to the dredge. By carefully timing the dredging cycle so that the start of the pump-out coincided with the high tide and also by adjusting the load according to tidal height, it was possible to bring in loads that varied between 6,000 and 10,000 cubic yards. The distance to the pumpout site from Ambrose Channel was about 12 miles.

Two timber pile breasting dolphins were constructed in the bay to which the dredge was tied up while unloading. About 12,000 feet of pipe was laid, which included about 2,000 feet of submerged line from the mooring site across Sandy Hook Bay to an area just south of Holly Forest, and about 6,000 feet of pipe along the shoulder of the road to the northerly end of the critical zone, where it went under the access road and to the beach. The pipe of the beach varied in length as pipe was added and removed to hydraulically build up the beach in southerly and northerly directions.

Phase I was completed in February 1983 and was successful in reestablishing a beach in the critical zone. However, much more sand was needed. Fortunately, during Phase I, additional funding was approved by Congress, and permission was received to negotiate a supplemental agreement to the original contract to take advantage of the fact that the dredge plant and pipeline were already in place.

During this second phase, an additional 1.4 MCY was placed with the sand obtained from dredging in Sandy Hook Channel. The beach in the critical zone was raised to an elevation of 10 feet and was extended a distance of about 1,200 feet from the access road.

A total of about 3 MCY of sand was placed during the three phases at a cost of over $21 million. Of this total, about $7 million represented O&M funds for the channel deepening while about $14 million was obtained through the NPS.

Overall, the project accomplished its goal of establishing a wider beach that serves to both prevent a breach of the Hook as well as providing the widest recreational beach in northern New Jersey. However, regular nourishment will be required to maintain this shoreline. The utilization of the nearby navigation channels will provide a source for this nourishment. Table 1 shows the three phases of beach nourishment work that took place and their associated costs.

Table 1

Summary of Dredging and Beach Placement Contract Costs at Sandy Hook

Phase of Work	Date	Sand Source	CY Placed	Cost
I	Nov 82-Feb 83	Ambrose Channel	1,026,860	$9,100,000
II	Feb 82-Aug 83	Sandy Hook Chan.	1,346,145	7,659,000
III	Apr 84-May 84	Sandy Hook Chan.	604,537	4,254,000
			2,977,542	$21,013,000

Other Productive Uses of Ambrose Channel Dredged Material

In addition to the use of Ambrose Channel dredged material as beach nourishment, we in the New York District have also used it as cover material in an innovative capping study that took place in 1981 (O'Connor and O'Connor 1983). This study demonstrated the feasibility of capping as a way to isolate contaminated dredged material from the marine environment. Ambrose Channel sands have also been utilized in constructing an underwater berm within a subaqueous borrow pit (Bokuniewicz, Cerrato, and Hirschberg 1986).

Most recently, we have been able to put Ambrose Channel sand to productive use while wearing our "Regulatory Hat." In 1985, we issued a permit to dredge to depths down to 53 feet below mlw in Ambrose Channel for the purpose of industrial sand mining. Not only does this get the channel dredged at no cost to the Federal government, but the permittee pays royalties to the respective States of New York and New Jersey where the sand was mined.

Since the permit was issued, about 2 MCY of sand has been mined within Ambrose Channel. At 25 cents per cubic yard, this has generated about $500,000 in royalties to the States of New Jersey and New York. The mined sands are transported by hopper barge and pumped to a dewatering and stockpiling facility in South Amboy, New Jersey. The sand is then washed and otherwise processed to produce fine aggregate for concrete. About 85 percent of the sand leaves South Amboy by barge destined for the various New York Metropolitan Area concrete plants, and the rest is moved by truck.

This permittee uses Ambrose Channel sand exclusively and is presently the largest supplier of fine aggregate in the Metropolitian Area. About 90 percent of all concrete poured in Manhattan at the present time utilizes sand dredged from Ambrose Channel.

This mining operation appears to be one in which everyone wins. We in the Federal government have saved about $1,500,000 for each of the past 2 years by not having to maintenance dredge that portion of Ambrose Channel. The States of New York and New Jersey (primarily New Jersey) have received $500,000 in royalties. The permittee has a steady and reliable sand source, reducing the need to exploit rapidly diminishing upland sources of sand.

Summary

PL 99-662 authorized channel deepening in Ambrose Channel to 55 feet below mlw. With the mining that has taken place to date, and that is likely to take place over the next few years, it is quite possible that these authorized dimensions could be achieved without any government expenditures whatsoever. With Amborse Channel deepened, deeper draft vessels will be able to enter New York Harbor than at present, thereby improving the competitive position of the Port of New York. Dredged material from Ambrose Channel has become a valuable resource that has been utilized in productive and environmentally beneficial ways--as a source of sand for beach nourishment,

as a means of capping contaminated sediment, and as a revenue-producing industrial sand.

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BEACH NOURISHMENT AND SHORELINE STABILIZATION: BIOTECHNICAL STABILIZATION OF DREDGED MATERIAL SHORELINES

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Introduction

The CE has many dredged material deposits that are subjected to moderate to high wave energies caused from wind fetch or ship wakes. Instability of disposal site shorelines caused by waves is a problem and is expensive to correct through traditional approaches such as riprapped revetment. This paper discusses biotechnical approaches to achieve stability of deposits that are more cost-effective than traditional approaches and that offer other alternatives for the combined benefits of shoreline stabilization and wildlife and fisheries habitat development.

Biotechnical stabilization, as the name suggests, involves the use of mechanical elements (structures) in combination with biological elements (plants) to arrest and prevent erosion. Biotechnical approaches have been used for several decades in Europe to control streambank erosion (Seibert 1968; Schiechtl 1980; Gray and Leiser 1982) and have more recently been used experimentally by WES to control dredged material shoreline erosion (Allen et al. 1978; Allen and Webb 1983; Allen, Webb, and Shirley 1984; Allen, Shirley, and Webb 1986). Biotechnical approaches used in four moderate to high wave energy environments that show promise in stabilizing dredged material shorelines and deposits have been applied at several gulf coast locations and in North Carolina.

Moderate to high wave energy environments are defined as having average fetches over 9.0 kilometres, and are areas typical of headlands and straight beaches.

Marshes and Breakwaters

Three biotechnical stabilization approaches entail the use of marsh and breakwater combinations. Marsh grass sprigs (rooted stems) are transplanted shoreward of a breakwater structure. The breakwater is only necessary the first 2 to 3 years after planting, until the marsh sprigs spread by rhizomes and completely cover the target planting area (Newling and Landin 1985). Since breakwaters are only needed temporarily, consideration should be given to less expensive and more expedient types. WES has used sandbag, floating tire (FTB), and tire-pole breakwater approaches to stabilization.

Sandbag Breakwater

A sandbag breakwater was successfully used 1975 through 1978 to develop salt marsh on a sandy dredged material site on Bolivar Peninsula adjacent to Galveston Bay, Texas (Figure 1) (Allen et al. 1978). A breakwater with a 305-metre-long and 1.5-metre-wide front was constructed from 0.5- by 104- by 2.9-metre nylon-coated bags. Sprigs of smooth cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*Spartina patens*) were planted shorewards of the sandbag breakwater in experimental plots. The developed marsh is the only marsh on the bay side of the Bolivar Peninsula, partly because of a long, 32-kilometre northwest wind fetch that produces large waves in the winter. The sandbag breakwater provided enough initial protection of the transplants for marsh establishment to occur, and the marsh is still functioning very well (Newling and Landin 1985, Landin 1986).

Sandbag breakwaters and smooth cordgrass sprig combinations are applicable to areas in northern US coastal areas if medium- to coarse-textured sand is used as sandbag fill material. Fine-textured sand tends to percolate through the weave of the fabric and destroys the integrity of the sandbag and the breakwater. Ice flow could be detrimental to a sandbag breakwater in northern climates unless measures are taken to securely anchor the bags in place.

Floating Tire Breakwaters

FTB and shoreward salt marsh plantings have been successfully used to stabilize shores of unconfined dredged material deposits at sites on the gulf coast. In 1981, a two-tier FTB (Figure 2) and smooth cordgrass sprigs stabilized part of a dredged material dike in Mobile Bay at Gaillard Island (Allen and Webb 1983). The dike formed one side of a three-sided, 485-hectare confined disposal facility (CDF) in the middle of Mobile Bay (Figure 3). The stabilized area is subject to an 11.2-kilometre fetch from the north. The FTB was built and installed after a previous, conventional marsh planting had washed out.

A three-tiered FTB was tested in 1984 at Bolivar Peninsula, 1 kilometre west of the 1975 site described under the sandbag breakwater. The configuration was selected for field testing after wavetank studies demonstrated that it could reduce wave energies by as much as 80 percent (Markle and Cialone 1987). Smooth cordgrass was planted shoreward of the breakwater using both conventional single stem and biotechnically stabilized transplants, which will be discussed later in this paper. Plantings unprotected by a breakwater were also established nearby as a control. Twenty-seven months after planting, the protected area had an average of 43-percent coverage by smooth cordgrass. The unprotected, conventional plantings did not survive. Forty-three percent coverage after 1 to 2 years is similar to that seen at the original Bolivar Peninsula (sandbags) site. Expansion of the marsh has increased, and continued marsh growth and spreading are expected at that site. The original Bolivar Peninsula site, the newly planted site, and a control dredged material deposit to the east of the original site are being monitored and compared for establishment, stabilization, and colonization.

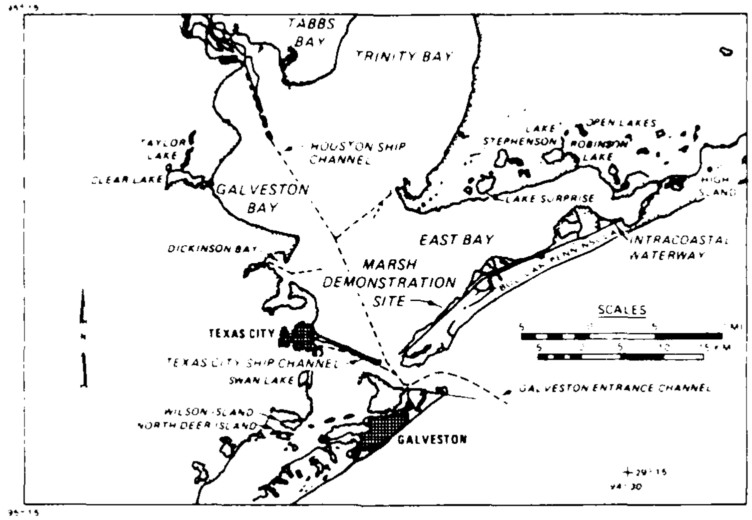


Figure 1. The Bolivar Peninsula marsh establishment site next to Galveston Bay, Texas

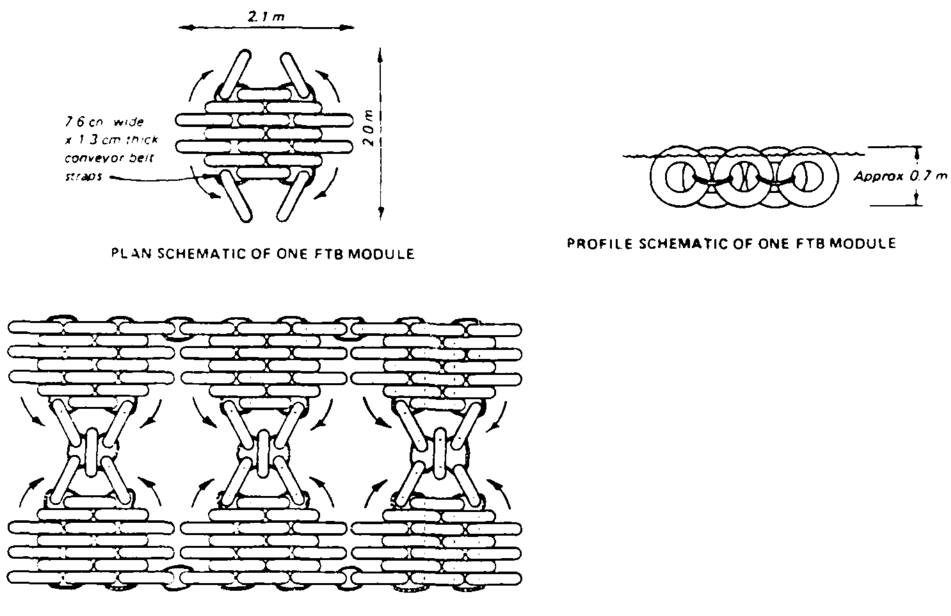


Figure 2. The marsh at Gaillard Island stabilized by as two-tier FTB

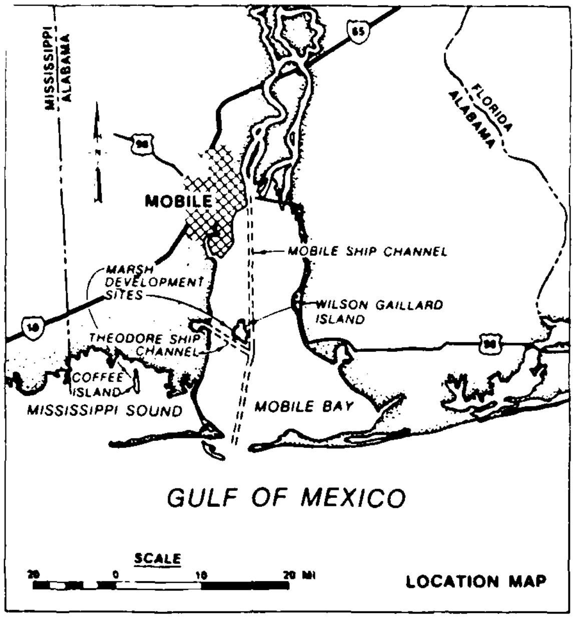


Figure 3. An aerial view of Gaillard Island CDF, showing the three-sided dike configuration and the shipping channels

FTB and marsh combinations have application to northeastern US sites with some restrictions. Ice flows may break anchor straps and jeopardize the integrity of the breakwater unless tire modules making up the breakwater are disassembled and portions of the breakwater are towed to an area of safekeeping for the winter. This can be achieved by tying several tire modules to a boat or barge, and floating them elsewhere.

Tire-Pole Breakwater

Another breakwater structure consisting of tires threaded on 15.2-centimetre-diameter poles (Figure 4) was also tested at the Bolivar Peninsula site in 1984. Shoreward plantings similar to those used behind the three-tiered breakwater were tested. Twenty-seven months later, marsh has extended across most of the protected area with an average 47-percent plant cover in the stand. Only a relatively unprotected area at an open end of the breakwater has failed to vegetate. As with the three-tiered FTB area, marsh grass coupled with the tire-pole breakwater has expanded and is expected to continue to thrive.

Tire-pole breakwaters for initial marsh protection should be used with caution at northeastern US sites because of the potential for ice problems. Ice flows may create too much strain on the horizontal poles holding the tires, thereby breaking them and destroying the integrity of the breakwater.

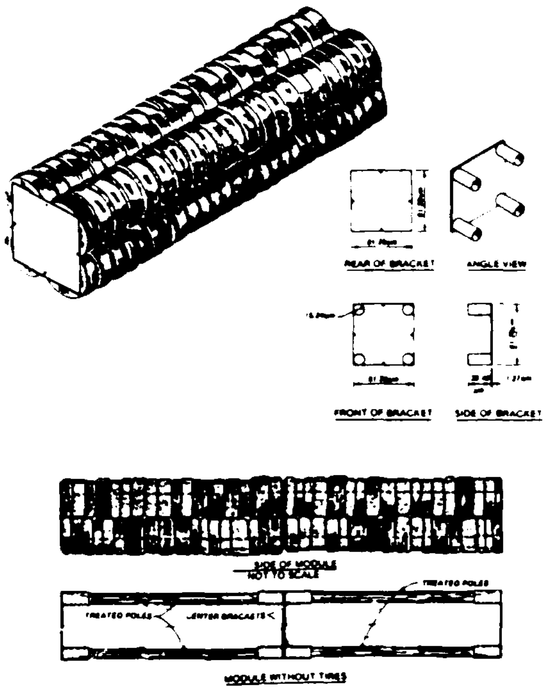


Figure 4. A tire-pole breakwater used at Bolivar Peninsula to stabilize the salt marsh planted there

Biotechnical Approaches for Plant-Stem Stabilization

Breakwaters are good means of promoting marsh establishment, but other more visually attractive and possibly less expensive biotechnical approaches exist that may be just as effective. In 1983, WES began to work with planting techniques that focus on plant-stem stabilization. The concept is to strengthen the attachment of the plant to the substrate to reduce the likelihood of its being washed out by wave attack, thereby avoiding the necessity of a breakwater.

Twelve plant-stem stabilization and conventional planting techniques were tested in Mobile Bay in 1983. The techniques were exposed to wave of various fetches and directions, the maximum being an 11.2-kilometre fetch from the north (Allen, Webb, and Shirley 1984). The conventional single-stem planting techniques proved unsuccessful. Three techniques using erosion control mats, plant rolls, and burlap bundles demonstrated enough potential at Gaillard Island that they were subsequently tested in demonstration plots at Bolivar Peninsula and at Southwest Pass in the lower Mississippi River. Potential usefulness of the plant rolls was also demonstrated along a 0.5-kilometre front at Coffee Island in Mississippi Sound. Results of these demonstrations are described in detail in Allen, Shirley, and Webb (1986), and successful approaches are summarized as follows.

Erosion Control Mat

A biodegradable fabric mat called paratex which consisted of 0.1-kilogram per square metre natural fibers was laid like carpet on the shore at the previously described Bolivar Peninsula site. Single stems of smooth cordgrass were planted on 0.5-metre centers through slits cut into the mat (Figure 5). The edges of the mat were nailed between 5- by 15-centimetre boards that were buried in the sediment (Allen, Webb, and Shirley 1984). Four 6- by 9-metre plots of the planted mat were placed adjacent to, parallel with, and outside the immediate influence and protection of the breakwaters. Twenty-seven months later, three of four original plots remained with an average 41-percent plant cover. Success within the remaining plots was similar for both those plots protected by breakwaters and those unprotected.

This approach is currectly being expanded to include mats that have "pregrown" marsh grass, in which smooth cordgrass seeds are sown on the mat, germinated, and allowed to grow to seedling stage in the nursery. When the seedlings develop sufficient root systems, the mats are transported to the fieldsite for installation. The approach is analogous to pregrown lawn sod that is grown at nurseries and transported to customers' lawns. Immediately upon installation, the marsh grass already has developed root systems that are ready to grow. When the mats arrive at the field site, segments of them are laid between woven wire and staked down with metal rebar to prevent washout.

This biotechnical approach may be very applicable to northeastern US dredged material sites because it offers plant stem stabilization without being jeopardized by ice flows that can cause problems with breakwater stabilization combinations. This approach may also be used on a variety of substrates.

Plant Roll

A plant roll is constructed by placing soil and six transplant clumps (several stems with one intact root mass) at 0.5-metre intervals on a strip of 3.7-metre-long by 0.9-metre-wide burlap. The sides and ends of the burlap are brought together around the plants and fastened with metal rings. This creates a 3-metre-long roll of plants and soil (Figure 6). The plant rolls are placed parallel to the shoreline and buried to such a depth that only the plant stems are exposed.

A mixture of single-stemmed transplants and plant rolls were successfully used at a demonstration site at Coffee Island (Figure 3) in Mississippi Sound. The site consisted of clayey dredged material and had a maximum fetch of 16 kilometres. Stabilization with smooth cordgrass was undertaken to control erosion. One row of plant rolls was placed end-to-end seaward of single-stemmed transplants (Figure 7a) over a linear distance of about 0.5 kilometre to cover an area 5 by 10 metres wide.

Periodic inspection of this demonstration planting revealed that new stems emerging from the plant rolls satisfactorily colonized and stabilized the eroding dredged material face (Figure 7b). Recent inspection of the site

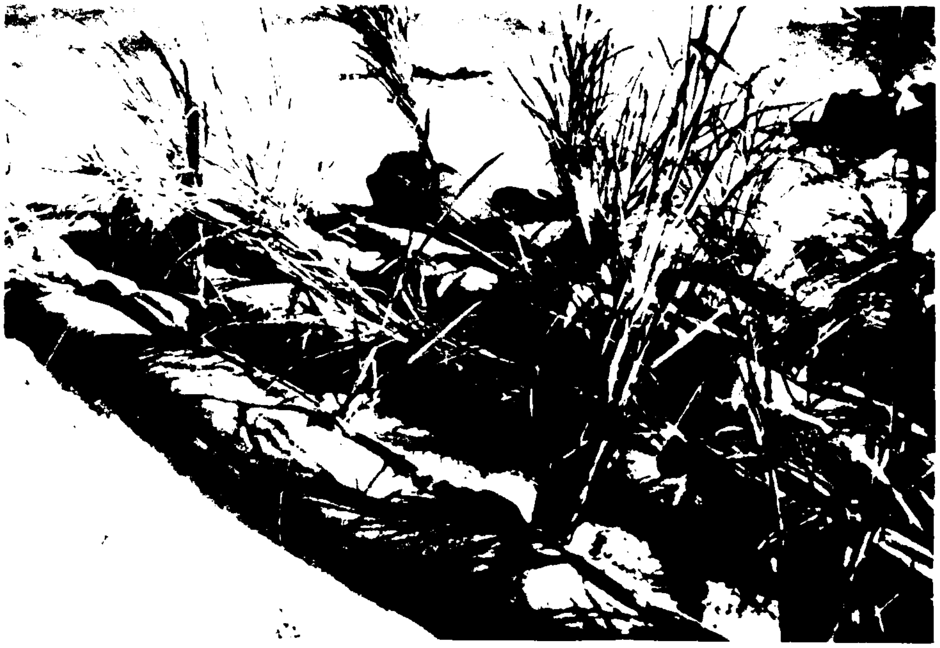
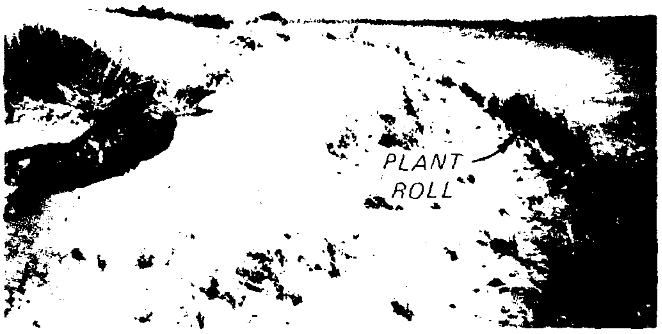


Figure 5. Single stems of smooth cordgrass to be planted in slits cut in paratex erosion control mat

Figure 6. Plant rolls waiting to be placed along the dredged material shoreline at Gaillard Island, Alabama



a. Plant rolls in place at the field site

b. Plant rolls after 3 years

Figure 7. Plant rolls have been used to effectively stabilize erosive shorelines in Alabama and Texas

Table 1

Costs of Planting Technique*

Planting Technique	Cost per Plant	Cost/Linear Metre (20 m deep)
Single-stemmed plants (conventional planting)	$0.15	$ 12.00
Plant roll	0.60	48.00
Paratex mat	1.58	126.00
FTB with planted sprigs	1.58	126.00
Tire/pole breakwater with planted sprigs	1.95	154.00
Sandbag breakwater with planted sprigs**	3.35	265.00

* Costs are based on an hourly labor rate of $6.00 plus $0.10 per plant for digging, gathering, and transporting. Costs of materials are included; other direct and indirect costs are not included. Costs per linear metre also assume that plants are placed on 0.5-metre centers and are planted in a swath 20 metres wide.

** Costs of the sandbag breakwater construction are based on those given by Eckert, Giles, and Smith (1978) for a 1.5-high breakwater.

found marsh fringe which showed signs of accreting sediment, a feature which will further protect the island from erosion.

Plant rolls containing smooth cordgrass are currently being tested at eroding dredged material sites along the Atlantic Intracoastal Waterway (AIWW) near Wilmington, North Carolina. Waves from large pleasure boats are eroding the shorelines of dredged material deposits, and the plant rolls will be evaluated as to their effectiveness in controlling shoreline erosion from these types of waves. If they prove successful in this kind of situation, they may have broader applicability to sites further north along the AIWW than previously thought.

This biotechnical approach has potential at northeastern US sites and, unlike some breakwater approaches, may not be jeopardized by ice since the rolls are placed in the substrate and are not apt to be carried away by ice masses.

Costs

Costs of biotechnical techniques using marsh are given in Table 1, and range from $48 to $154 per linear metre for a marsh 20 metres wide (seaward to shoreward). Traditional erosion construction techniques are much more expensive than these vegetation alternatives. For example, costs for rock revetments are approximately $688 per linear metre for an area 20 metres wide, and wood and steel sheet-pile bulkheads range in cost from $1,575 to $1,837 per linear metre (Eckert et al. 1978).

Conclusions

Some of the biotechnical approaches described in this paper are still experimental in nature and must be used with that in mind. They do offer considerable promise as cost-effective stabilization alternatives to traditional methods such as riprap. They also have the additional values of providing wildlife habitat and being environmentally compatible, while improving site attractiveness.

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QUESTION: Have your data been published anywhere?

MR. ALLEN: They've been published in WES technical reports and notes, and the proceedings of the Wetland Restoration and Creation Conference held each year in Tampa, Florida.

QUESTION: Could you give me the name of the sandbag manufacturer?

MR. ALLEN: We can get that for you. We had a vendor in Florida furnish the ones we used. There is a problem with the sandbags in that at our site, sand filtered through the fabric due to the fine-texture of the sand. We had to put filter cloth underneath and between the bags. They are really designed for coarse-textured sand.

COMMENT (LANDIN): Sandbag dikes were also used by Wilmington District in 1979 and worked very well to stabilize a dredged material island they built in Core Sound, North Carolina, for seabird nesting. They did some stabilization insurance work by coupling the sandbags with marsh development.

QUESTION: I am very pleased to see the FTB. I did the original research on these at the University of Rhode Island in 1974. New England CE Division gave us a cease-and-desist order at that time because they didn't want tires in the estuaries up there. Your costs are high--if you reuse the FTS's, the cost per linear foot is much less. We also had trouble with FTS's placed on the beach. They filled with sand. Has anybody deliberately placed them on the beach, pumped sand around them, then planted over the top? These would make good permanent anchors for dunes or beaches.

MR. ALLEN: As it turned out, at Gaillard Island we intended to move the FTB. However, Mobile District wanted us to leave it because it was doing such a good job of sand accretion and dike stabilization. It actually

formed a groin at that end of the island, and it acted as a tripping device for waves.

QUESTION: There was one put in at Traverse City, Michigan, to protect a sewage treatment plant. It formed a mat that extended below the water and up on the beach, but Detroit District ripped it all out. They didn't go along with our experiment, but it was working well, and plants were growing in it. Are you going to do this on a long-term basis?

MR. ALLEN: We're shooting for long-term tests on FTB's and other biocontrol techniques in subsequent work, on a larger site rather than on small test plots.

QUESTION (CHRISTOFFERS): We have used sandbags in Chesapeake Bay but not FTB's. We could have problems with FTB's due to cold weather. What are the problems associated with them?

MR. ALLEN: FTB's can be towed to shore or a protected area for the winter just prior to freeze up, so they should be manageable in cold regions. If they are left in place, ice could cause them to break apart or put them up on shore.

COMMENT (MR. PAT LANGAN): I wanted to say that in Mobile District at Gaillard Island where FTB's were used with marsh development, the District realized a cost-savings from that one stabilization project of over $1 million.

COMMENT: I have one comment on PL 99-662 which calls for a 50:50 cost-sharing for beach nourishment. The difficulty comes in that it costs the local sponsor 100 percent to put it on the beach, and the money often isn't there. We have sites in the State of Maryland that need beach nourishment, and there simply is not money available for the local share.

QUESTION: I have heard talk about sand in piles in nearshore areas for wave attenuation called various things. Correct me if I am wrong, but I thought the technical term for these sand piles was "Murden's Mounds"?

COL WALSH: Exactly!

QUESTION: Is the sand mining company limited in the amount of sand it can dredge from the channel, or can they take whatever they need?

Mr. SLEZAK: The permit limits it to 2 MCY per year.

QUESTION: Does this eliminate the need for dredging, or is it in excess of that need?

MR. SLEZAK: That's actually in excess of dredging requirements.

QUESTION: At what point would it be considered a problem if the sand mining company deepened the channel?

MR. SLEZAK: The permit limits them to 53 feet. They also must dredge evenly no deeper than 53 feet throughout the channel.

QUESTION: So essentially they can be putting themselves out of business?

MR. SLEZAK: No. Technically, there's always a possibility of widening the channel as well. Potentially, the availability within the permit is not time limited. At least a 400,000-cubic yard recharge occurs each year.

QUESTION: Have you done any offshore berm work associated with dredging projects that will eventually recharge sand on the beaches?

MR. SLEZAK: We've disposed sand in an underwater berm at Sandy Hook, New Jersey, on two occasions, in relatively small operations. We didn't do detailed monitoring, but they didn't seem to be tremendously successful. At Sandy Hook, there is a trough that slopes up quite rapidly. One of the benefits to placing sand there is to help fill in the trough. The sand may never have gotten to the beach. The next time we do this, we will monitor more carefully.

QUESTION: Did the sand-mining company have to apply for a permit, or did you automatically give them one?

MR. SLEZAK: Yes, they applied for a permit like everyone else. The mining company came to us with the idea, and we mutually developed the mining/dredging plan, then issued them a permit.

INDUSTRIAL AND COMMERCIAL APPLICATIONS OF DREDGING: OPENING REMARKS

Thomas Schina, Moderator
US Army Corps of Engineers
Philadelphia, Pennsylvania

You have heard already during the workshop about wetland creation, habitat development, beach nourishment, and shoreline stabilization. Now you'll have a change of pace and hear about some of the industrial and commercial applications of dredged material which make up a very large part of actual beneficial uses of this material. I'd like to ask you to hold your questions until after our distinguished speakers have made their presentations.

Our first speaker this morning is Dr. August D. Pistilli, President of the American Dredging Company headquartered in New Jersey. He is also a Commissioner of the Delaware Port Authority. Gus will give an overview of commercial and industrial applications of dredged material with which his company has been involved over many years.

Our second speaker is Mr. Frank L. Hamons. Frank has a background in ecology and biology and is currently the Director of the Office of Harbor Development in the Maryland Port Administration. For 13 years, he was with the Maryland Department of Natural Resources and served as Chief of their Planning Division and as Chief of Technical Analysis. Frank will talk to us about harbor development and beneficial uses here in the City of Baltimore.

Our final speaker is Dr. John L. Buzzi. Jack is a member and past chairman of the Save Our Port Coalition, which has been instrumental in the restoration and vitalization of the New York/New Jersey Port. He is treasurer of the CE Public Involvement Coordination Group, which reviews all dredged material disposal projects in the Harbor. He also presides as Chairman of the New Jersey Department of Commerce Economic Development Advisory Council. He is president of Kupper Associates and is a member and past chairman of the New Jersey Alliance for Action. Dr. Buzzi will talk to us about getting public and local government support for dredged material disposal methods and projects.

INDUSTRIAL AND COMMERCIAL APPLICATIONS OF DREDGING: OVERVIEW OF INDUSTRIAL AND COMMERCIAL USES OF DREDGED MATERIAL

August D. Pistilli, President
American Dredging Company
Camden, New Jersey

Thank you, Tom. I brought a few handouts that list a number of beneficial use projects along the east and gulf coasts (Table 1), and I want to show you some slides of some of our projects. These are projects that V. G. Hussin of Great Lakes Dredge and Dock Company, and I of American Dredging Company as old-timers in the dredging industry have been personally involved with. We left out the foreign, west coast, and Great Lakes projects, and just tabulated jobs we thought showed beneficial uses of dredged material, industrial, commercial, and otherwise here in the east.

In recent years, we have been faced with the problem of what to do with dredged material. In years past, we had a lot of uses for it in land fill, agricultural and horticultural use, port and urban development, and numerous other ways of getting rid of the material. No doubt about it, PL 99-662 has increased the problem, and it's double-barreled. As the need for dredging increases and a 10- to 12-year backlog of port development dredging work has piled up while PL 99-662 was in the works, there have been a decrease in disposal areas and an increase in environmental restrictions. We are somewhat more sophisticated now in the way we handle material, in time of dredging, and where and how we place the material.

Obviously, we must address the problem--it is in all our best interests. What's going on in Vicksburg in the dredging programs since the 1970s reminds me of a George Bernard Shaw play where they take in a little street urchin and make a lady out of her. That's where the dredging and dredged material disposal business used to be. We've taken an old harlot and put a new dress on her and call her dredged material, not dredge spoil. And that's only the first step! We could go on to the next step and call it "processed alluvial deposits" or "subaqueous borrow material" or how about "fine-grained sanitary landfill encapsulation?"

I have been involved in a lot of jobs where we've done beneficial uses, not for the sake of beneficial use of dredged material, but for profit. If Philadelphia District will pay me $2 to dredge a cubic yard of material and I can sell it to someone else, I have $4. That's not a bad deal, and that's how beneficial uses works in the industrial and commercial world. The idea is to get paid for it twice.

Now maybe you can't do that in your position, but you can do things with this resource material besides treat it as a waste product. Some of the examples of beneficial uses the dredging industry has created include Washington National Airport, Philadelphia International Airport, Newark Airport, Kennedy International Airport, the New Jersey Turnpike, the Atlantic City Expressway, most of downtown Washington, Baltimore, Philadelphia, New York, and Norfolk, large islands in Tampa Bay, and many many others. Look at the market place. If you can convince people that dredged material is a resource, you can sell

the concept of beneficially using the material. Even with all the engineering and biological constraints, this material is well worth evaluating for potential beneficial uses. Other examples we've built include beach nourishment projects, several areas at Port Elizabeth, New Jersey, nuclear power plant foundations, and my own company's headquarters.

The slides I am showing you are just a few examples and a brief overview of what can be done with dredged material. I'd like to leave you with this thought. Rather than thinking of dredged material disposal as a problem, consider it an opportunity--an opportunity to do something useful with the material that could benefit mankind, natural resources, or both.

Table 1

Industrial and Commercial Beneficial Uses of Dredged Material in Selected Projects on the East and Gulf Coasts

Date	Location	Job Description	Quantity (MCY)
1939	Brooklyn, NY	Long Island Belt Parkway	5
1942-43	Long Island, NY	Kennedy Int'l Airport	25
1943-46	Boston, MA	Logan Int'l Airport	44
1955-56	Norfolk, VA	Craney Island	3
1956	Mantua Creek, PA	Philadelphia Int'l Airport	1
1957	Delaware River, PA	Embassy Food Dist. Center	1.5
1960	Miami, FL	Dodge Island Port	4
1960	US Steel slip	Filled abandoned borrow pit	1
1961	Delaware River	Commercial sand & gravel	5
1962	New Jersey	Beach nourishment/storm repair	4
1963	Indian River, NJ	Beach nourishment/hwy. fill	1
1964-66	Newark, NJ	Airport expansion	23
1965	Tampa, FL	Tierra Verde site	5
1965	Newark Bay, NJ	Highway fill from channel dredging	2
1965	Mussel Beds, NH	Bay bottom nourishment	----
1966-68	New Jersey	NJ Turnpike contracts	10
1967	Albany, NY	Highway interchange	2.5
1967	Tioga, PA	Marine Terminal	2
1967	Delaware River	Penn's Landing Marina	2
1967-68	Delaware River	Addition/Phila. Airport	6

(Continued)

(Sheet 1 of 3)

Table 1 (Continued)

Date	Location	Job Description	Quantity (MCY)
1968	Lower NY Bay	Route #3 embankment	2
1968	Lower NY Bay	NJ Turnpike embankment	7
1969	Delaware River	Packer Avenue Terminal	1.5
1970-80	South Atlantic coast	I-95 highway fill	10
1971-74	Marcus Hook, PA	Rehandling basin	1
1972	Marbor Island, TX	Beaumont Shipping Terminal	1
1972/1981	GIWW, New Orleans	Lake Ponchartrain levee	3
1974-75	Miss. River, LA	Hurricane protection levee	4
1974-75	Fire Island, NY	Beach nourishment	3.2
1975	Miami, FL	Dodge Island expansion	2
1975-82	Miami, FL	Beach nourishment	15
1978	Barnegat Inlet	Beach nourishment	1
1978-85	Rockaway Beach	Beach nourishment	5
1980	Miami, FL	Lummis Island	2
1980	Newark, NJ	Meadowlands fill	3.5
1981-82	Baltimore, MD	Hart-Miller Island	5.8
1982	Greater Egg Harbor	Beach nourishment	1.1
1983	Waterwharves, NJ	Wetland creation	0.25
1984	Townsends Inlet,NJ	Beach nourishment	1.6
1984	Corson's Inlet,NJ	Beach nourishment	1.5
1984	Indian River, NJ	Beach nourishment	0.5
1985	Carolina Beach, NJ	Beach nourishment	1.5

(Continued)

(Sheet 2 of 3)

Table 1 (Concluded)

Date	Location	Job Description	Quantity (MCY)
1986	Wrightsville Beach, NC	Beach nourishment	2
1986	Atlantic City, NJ	Beach nourishment	1
1986-89	Delaware River	Subaqueous dike construction	1.5
TOTAL			225 MCY

(Sheet 3 of 3)

INDUSTRIAL AND COMMERCIAL APPLICATIONS OF DREDGING: THE POTENTIAL FOR INNOVATION IN THE COMMERCIAL USES OF DREDGED MATERIAL

Frank L. Hamons
Maryland Port Administration
Baltimore, Maryland

We're looking hard at dredged material beneficial uses in Baltimore now in the area of harbor development. With my background in natural resources, it has enhanced my perspective of dredging problems. I'd like to take this opportunity to commend the CE in holding these workshops. They are enormously useful. As I look out at the audience, I see citizen groups, dredgers, A&E firms, natural resource people, regulators, marina owners--all the players are here, which means we can deal with the problem if all sides are represented and listening and talking to each other. A lot of people get tunnel vision, and these workshops give them an opportunity to open up.

I'd like to encourage the CE to consider getting into regional programs, to encourage participation, and to address what might be done. The next step is to apply some of the work the CE has done. I sometimes think their dredging body of knowledge is tremendously underused by other agencies and groups. WES's dredging program reports and technology are available to everyone if people would just take advantage of it. So much for my endorsement of the CE, and we expect a better cost-sharing deal from you guys! We don't want to pay 50 percent of the project costs until we get 50 percent of the decisions--now there's an area we need to talk about.

We have some beneficial uses in Maryland and in the Chesapeake Bay. I'll give you just a quick example in Hart-Miller Island (HMI). HMI is a 1,100-acre, 1- by 2-mile, confined disposal island which the State has promised will become a recreation/wildlife/natural resources area when filled and completed. Getting from the drawing board to a completed island requires a huge amount of effort. The concept of beneficial uses has its own set of problems, and it is sometimes not an easy thing to do.

We are filling HMI now and have put about 16 MCY in it so far. Some of the dredged material from the Baltimore Port Deepening will go there. We are developing a transition and a completion plan for HMI, based on potential capacity, dredging schedules, dike heights, and other factors. There are a large number of people who want to use HMI for recreation, and it already is receiving wildlife use. How do we allow for continued operation and the needs of the people in that part of the bay? Some of the dredged material is clean and could go anywhere. Some of it is contaminated and has to be confined. There are a lot of questions to be answered in building a site like HMI. No question is simple, and no answer is final, in dealing with an evolving project like this one.

We have high hopes for a Regional Master Plan for dredged material disposal in Maryland that we are kicking off. We want to create as much beneficial use of this material as we can and avoid some of the mistakes of the past. One of the mistakes we made on HMI was not getting and educating the

public about the island's purpose and use, and we spent the first 5 years trying to get local and State permits and approval, and the next 5 to 6 years after that in court answering to environmental groups! At the start of this project in 1970, we never dreamed it would take until September 1981 for approval. Costs went from an estimated $11,500,000 to an estimated $53,000,000, and actual costs may run to $60,000,000. Since PL 99-662 has passed, we now also have got into cost-sharing that we hadn't dreamed of 17 years ago at the project start. We should have allowed those private citizens and local officials who have a vested interest to be involved early in the planning process.

We are including that in our Regional Master Plan. We are at a stage on the plan now of finalizing a list of participants on the Advisory Committee. The list is making its way through bureaucracy, and that will probably take longer than it did to compile in the first place! It's a major activity at this stage in the plan, because if you miss someone, you're in trouble and already off to a bad start.

We set up two Advisory Committees. The first is made up of general citizen groups and representatives of all kinds, and the second is made up of agencies who have interests and responsibilities for any regulation of dredging. We will probably have some joint meetings also. We want their involvement from the very start. Our approach is to try to develop a body of evidence to allow us to intelligently select dredging alternatives and combinations of alternatives that can apply in our area of Chesapeake Bay. We want to be as objective as possible, using hard data and responsible projections to make our plan decisions. I've found that people are usually willing to go along with you even if they don't agree, as long as they understand your approach and rationale. Without that, they just bite you in the neck! It becomes more and more difficult to get people to think objectively and rationally once polarization has occurred.

We have developed at this point a Master Plan document that gives background, objectives, scope, description of dredging needs, future port plans, disposal site needs, and projected dredging volumes. We stopped at this point until our Advisory Committees were in place and functioning. Once that happens, we will move on to potential disposal places and alternatives with the committees' input. I won't go into all the details, but we will look at short- and long-term impacts both good and bad, natural resource use, economics, future site uses, and mitigation.

We are now incorporating mitigation plans into every project we propose to do in the bay. We think this may help with project approval if we propose mitigation up front, and we realize mitigation is here to stay.

The importance of a good game plan cannot be overemphasized. Our port, and I think many ports, have been operating project by project. We were always coming from behind because of this. This makes us fall back on the old disposal standbys. There's nothing wrong with this, except that everybody says, "You're always falling back on the old standbys, and we don't want you to do that!" If the old standbys have been evaluated along with new concepts, there's certainly nothing wrong with using them.

No plan is perfect, but it provides a basis for acceptance. Plans should be updated and reevaluated every few years to keep them current. We are justified in Maryland in developing a plan. We have literally hundreds of miles of channels serving this port. They are the arteries and lifeline that supplies the port. An estimated 10 to 25 percent of all Maryland products move through Baltimore Port.

We can't ignore the needs of the port. We can't ignore the environmental problems in Chesapeake Bay. We can address these together as long as we approach it on a regional basis with a Master Plan.

I didn't give you a lot of technical information today, rather just an overview of the port's plans and needs. I'll be glad to answer any questions after the next talk and on the tour of HMI tomorrow.

INDUSTRIAL AND COMMERCIAL APPLICATIONS OF DREDGING: WINNING THE SUPPORT OF THE PUBLIC AND LOCAL GOVERNMENT FOR DREDGED MATERIAL DISPOSAL METHODS

John L. Buzzi
Kupper Associates
Piscataway, New Jersey

Introduction

Our technical session today is Industrial and Commercial Applications of Dredging as part of this regional conference on the beneficial uses of dredged material. As a former college professor, I am going to outline for you what I intend to say, and it is broken down into a couple of parts.

How do you get this to happen? First, utilize public associations. Second, make beneficial use of governmental committees. Third, make input into development of a winning program for winning environmental permits and budget approvals. Fourth, understand what are the legislative impacts surrounding your program or project. Now let's discuss where we go from here.

Before I get into my presentation, I want to let you know that I really shouldn't be here speaking to you. I should not be your speaker. You should not have asked me to come here because I think I know what we are all talking about today. How many investment bankers are in the audience? Do we have a show of hands?

Who the hell do you think is going to raise the money for that local cost-share we've been talking about? They have a vested interest. We poor consulting engineers have to work for 4 to 5 percent of a project. All they have to do is sell a few bonds, shuffle some papers, and issue opinions. Of course, they have a liability that that all pays for! Where are they?

How many organized labor union guys are here? Who do you suppose man the boats that do all of this? Where are the longshoremen? Where are the guys driving the trucks? They're not here. How many guys from real estate development interests are here? Upland disposal is a major element of a well-balanced dredged material management plan. They could make beneficial use of it. Why aren't they here? So you see, if I left right now, you wouldn't miss anything--at least, not as far as getting the word out on beneficial uses of dredged material.

Let me give you some ways we went about winning approval.

Utilize Public Associations

Initially, we relied very heavily on the New Jersey area, and as the work started, we interrelated with our New York and Philadelphia partners.

Quite a while ago, on a much different issue, trying to get infrastructure moving on transportation, New Jersey interests included at that time consulting engineers, contractors, organized labor, and people who basically were at war with each other on any highway project. We tried to get them together and couldn't. That was the genesis 12 years ago for an organization that now includes investment bankers, real estate developers, insurance companies, organized labor, consulting engineers, dredgers, and any aspect of the community you could imagine. They are part of our New Jersey Alliance for Action.

What's its purpose? Basically, we discuss the issues and we really get into them! It is the broadest based coalition of its kind I know of nationwide. The Alliance is made up of "doers," not "regulators" or "watchers." Our goal is to cut red tape. Do whatever we have to do, but cut red tape.

The structure of the organization has nearly 500 members. We have a whiz of an executive director who will let you know immediately where you stand. We have a Board of Directors that operates with an Executive Committee. We handle business by phone and don't have meetings. We receive lots of mailouts to keep us informed. The budget is about $300,000 per year, and we have a very small staff. Most of the budget is used for outreach programs, to reach people not already involved who should be.

New Jersey ports are now shipping more tonnage than New York. Do you know that the New Jersey Department of Transportation does not have one single position dedicated to marine transportation. Why? We have acres of floor space dedicated to highways and rail--not one desk space to marine. The State of New Jersey is almost totally surrounded by navigable waterways.

I went to a meeting on New York Port promotion a few years ago, and they asked me what I was doing there. I explained about our waterways, ports, and jobs. So we formed the Save Our Port Coalition--both New York and New Jersey. We have since then almost put ourselves out of business. It used to take 18 months or more for people to get permits moving. We've worked with the CE, the State, and the Port Authority, developed a decision matrix to speed things up, and cut the permit time from 18+ months to 30 to 60 days.

The Water Resources Association of the Delaware River Basin--why are they interested in dredging? They are building master plans based on chasing saltwater intrusion and water quality up the Delaware River. So we got everybody together, and we held a conference in Atlantic City. We had the Commissioner of the New York City Department of Ports and Terminals interfacing with Philadelphia and Newark.

Beneficial Use of Governmental Committees

Quite frankly, we can have problems dealing with government agencies. We formed a group to work with government agencies. We made a deal--nice and simple. The business community sat down with the environmental community and discussed alternatives. They said, "We want you out of the ocean (disposal) business!" We said, "You can't shut us down unless you give us some alternatives!" They said, "We will try to help you find viable alternatives for

disposal if you will help us with environmental work." We said, "Sure!" We struggled along for 5.5 years on that one deal. We had mussel studies, and fish studies, and shrimp studies, everything.

Now, wouldn't you think New Jersey would have one person dealing with marine work? With a title like maritime coordinator? It's not in the Department of Transportation, but we do have one guy in the State agencies working on this. Gus (Pistilli) started working on this, and they put together a booklet called "New Jersey, the Maritime State." It's the first indication that New Jersey was even thinking about its maritime economic potential.

Winning Environmental Permits and Budget Approval

Don't let people steal your environment and your quality of life! This means your chance at a job, a house, places for your kids to go to school and play--it means a lot of different things, not just birds and bees. Don't get me wrong, my company and I are very environmentally oriented. We wouldn't be in business if we weren't, but there are other important things in life, such as jobs and homes. We must appreciate both sides of the equation.

The secret to winning permits starts with getting to know the permit people in permitting agencies. Go to them in time of need--not <u>your</u> need, <u>their</u> need! When their budgets are up for review, support them. When there is legislative action (money, staff, organization) in the works, take a positive position on it.

A case in point is the State of New Jersey's harbor drift removal project. In a casual conversation, Gus and I found out that they were complaining that the CE wasn't processing their permits fast enough due to manpower and budget constraints. I asked, "Have you talked to them?" They said, "Yeah, we've talked, and we have a meeting set up in 15 weeks." Well, I bridged some gaps, and in 3 days we had them talking. The District Engineer started the meeting by reviewing the permit process and challenged the State to run him out of money for permits. See how different the story is? All that was needed in this case was for the State to write a letter agreeing to take care of upland areas so drift removal won't continue to occur, which the State had not done!

Size up the problem. For example, we have been trying to raise our local cost-share for a project. Well, we couldn't get itemized figures from the CE to tell us how much the local share of the project was going to cost, but we finally did. Now we can ask the legislature for the money for the project, but it cost us valuable time waiting on those figures.

Legislative Impacts

We've all heard about PL 99-662. It is a very interesting document, and it weighs quite a few pounds. In the Northeast, we are Neanderthals when it comes to marshalling our legislators like they do in the South and the West. New Jersey has two very good, hardworking Congressmen who sponsored that bill, and once again New Jersey is probably the last state to realize how much we benefit from it.

Our State legislature has come up with two bills to raise funds for shoreline protection, and they are limiting the dredging and flood-control work to $2 million per year. They might as well forget it. I did my own calculations of two major flood-control projects needed, and one would cost $47 million per year and the other $30 million to satisfy the need. That's the money the guy who isn't here--the investment banker--would have to raise. So, we are in the middle of this thing. We have to make a deal--the dredgers and the flood-control people can't get the work done for $2 million a year. The Alliance supports neither of these bills and will support one that has a realistic projection of costs and expectation of addressing the problem.

In New Jersey, we've come up with some new incentives. Two good ones coming up are the creation of the Clean Ocean Authority, whatever that's going to be, and the Office of Policy and Planning. These are the new New Jersey buzz words. They might be just two more layers of bureaucracy. Find out what's going on in <u>your</u> state!

Summary

In summary, there is more than one way to accomplish things. A friend of mine formed Losers International. We meet once a year on Friday the 13th. We always invite all the legislators. If they don't show, we threaten to endorse them! Maybe that's what we should do with our dredging problems.

QUESTION (DR. BILL KLESCH): Could you tell me what role the CE will play in the Maryland Regional Master Plan?

MR. HAMONS: Obviously the CE is going to play a major role in any regional master plan. Philadelphia and Baltimore Districts are on the Advisory Committees.

DR. KLESCH: The reason I asked the question is that later on this afternoon we will be talking about long-term management strategies for dredging and dredged material disposal, and it sounds like Maryland and the CE are tracking along the same thought patterns.

MR. HAMONS: That will be a very interesting paper. The Port has 15 years of screw-up experience that led us to the development of our Master Plan!

COMMENT: Jack Buzzi is a very good candidate for our next governor. If it wasn't for him, the Port would not have been revived. There would be no ocean disposal, or it would be 200 miles offshore. He's an extremely dangerous man, however, because he has actually convinced people that ocean dumping is safer than upland disposal! In my opinion, he can be dangerous.

QUESTION: Do you agree with moving the Mud Dump Site out 20 miles?

DR. BUZZI: No, absolutely not. As a matter of fact, public perception and environmental politics are responsible for that. There is no reason based on hard data to move the site.

COMMENT: The problem is that dredged material and sewage sludge are perceived as the same stuff.

DR. BUZZI: Yes, and now sewage sludge is going to be moved 106 miles offshore. That doesn't solve anything but costs a hell of a lot of money. Dredged material in New York Harbor, which has designated disposal areas, constitutes only 4 percent of the total harbor area. If that 4 percent is so environmentally destructive and can't be put in the river bottom or ocean bottom, I want to ask all you regulators, who's watching the other 96 percent? How can you say it's such a terrible thing? I want those environmentally concerned people to go harrass someone over the 96 percent. People are winning political elections over this issue right now.

COMMENT: EPA made a decision to require capping the Mud Dump Site based on the best information available.

QUESTION: In original dioxin testing, what level did you test at?

EPA COMMENTER: It was based on parts per billion and parts per trillion.

QUESTIONER: Based on one test at that level, EPA made a decision that affected the entire structure and economics of the New York Harbor Deepening Project. Isn't that pretty dangerous from a scientific standpoint?

EPA COMMENTER: No, we don't think so.

THE WATER RESOURCES DEVELOPMENT ACT OF 1986 AND ITS IMPACT
ON THE BENEFICIAL USES OF DREDGED MATERIAL

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Office of the Secretary of the Army for Civil Works
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I am pleased to participate in this regional beneficial uses workshop, and I appreciate the kind invitation of BG Chuck Williams, the NAD Division Engineer, and his host District Engineer from Baltimore, Colonel Marty Walsh.

Our goal in the Assistant Secretary's office is to reach decisions in an effective and efficient manner in all the things that we do, including the use of excavated material and its placement at other locations. In our evaluations, we look at balanced use and conservation of all our resources. This includes environmental effects and budgetary constraints. All of these considerations are basic to our arriving at decisions. We strongly support the multimedia approach; consequently, we initially look at all options on an equal basis. We have made a lot of progress in laying out what the real impacts are of disposal of dredged material. Our public interest review process of balancing resource use and conservation requires close coordination with all concerned elements of the public. In this regard, I am quite pleased that the conference includes a good mix of both resource conservation and utilization interests, government agencies, academia, and the private sector.

We are very pleased with a number of things that are happening at the interagency coordination level with regard to management of water resources. We have an agreement that was initiated by NMFS to create marine habitat improvements along with developing CE projects. That's in a pilot study phase now, and we are very grateful to our NMFS collegues for promoting the idea. We are anxious and pleased to cooperate with them. While this agreement is much broader in scope than just using dredged material beneficially, I am aware of at least two spin-off projects within the Baltimore District involving the creation of additional acreage of submerged aquatic vegetation and shellfish habitat using dredged material.

The Chesapeake Bay cleanup is another excellent example of exceptional interagency coordination, both at the State and Federal level. Indeed, this ambitious cleanup effort would be considerably less than effective without such close and comprehensive cooperation.

In specific regard to dredged material initiatives, we are also directly involved and are assuming a technical leadership role in a major interagency cleanup program within Puget Sound in the State of Washington. This program involves developing effective cleanup measures for hot spots of highly contaminated bottom sediments within the Sound as well as an attempt to develop a consistent aquatic dredged material disposal management plan for Sound-wide application. We also have an agreement in the works with EPA dealing with the designation of ocean dredged material disposal sites. The agreement also addresses the monitoring and management of these sites.

On the international scene, we have been involved very heavily in the London Dumping Convention activities, and things look very favorable for reasonable and balanced consideration of dredged material disposal activities. The London Dumping Convention recently adopted a recommendation of an internationally scientific group on criteria to distinguish dredged material from other material that really has or may have adverse impacts, and recognizes that the vast majority of dredged material does not create a significant adverse impact on the environment. We are very excited about moving ahead in this direction, and that the London Dumping Convention findings are being conveyed to the public.

We have also been involved for some time now on the international level with scientific information and technology interchange in the area of dredging and dredged material disposal. A major export that the CE has to offer here is the extensive R&D data base we have developed on the environmental aspects of dredged material disposal, including test and evaluation procedures and protocols and regulatory frameworks. This information has served as a technical model for a number of programs for dredged material. This in turn has been very beneficial to the CE and the United States in general in that this international sharing of regulatory experiences has served to help verify and further refine our own domestic procedures. In return, we in the United States have obtained valuable international information on engineering techniques to increase the efficiency of our dredging equipment, with the attendant spin-off in environmental benefits and other areas such as specialized dredging equipment and techniques for removing highly contaminated bottom sediments. This is proving quite helpful to the CE and EPA in project evaluations under Superfund where dredging is potentially required.

These initiatives underscore the importance which my office and the CE are placing on innovation, effective interagency coordination, and the need to bring the full weight of science and technology to bear in the management of our Civil Works dredging program. The increasingly chronic problem we face nationwide in the disposal of dredged material coupled with the need to get our Federal deficit under control necessitates that we actively pursue innovative and cost-effective solutions. The anticipated national dredging requirements which MG Hatch summarized in his keynote address (existing dredging requirements; US Navy homeporting; Superfund and other waterway-related dredging cleanup projects; anticipated long-term dredging needs in lake and reservoir rehabilitation; and, of course, the port deepening projects now being initiated under PL 99-662) clearly indicate the need for new and cost-effective solutions to the disposal of dredged material.

In specific regard to innovation and the WRDA, I was asked to present my office's views on the anticipated impact that this Act might have on beneficial uses of dredged material. I believe that, given the large volumes of new work material to be generated, the fact that no significant contamination problems are anticipated, and given the obvious resource value of much of this material, there is an excellent potential for its application in a wide variety of beneficial ways. Indeed, several beneficial use applications are either now being applied or are being seriously considered in the planning process for these projects. An excellent example is the recent construction of a nearshore feeder berm in conjunction with the Mobile Harbor Deepening Project for the purpose of creating a more gentle underwater slope which

should reduce the shoreline erosion levels at Dauphin Island. Another example is the plan to restore approximately 30,000 acres of delta wetlands with construction material derived from the proposed New Orleans Deepening Project.

Congress apparently shares this view, as several study authorities are included in the Act relative to a wide range of beneficial use applications for dredged material. Examples include Sections 933 asnd 1154 on beach nourishment, Section 847 authorizing the removal and sale of dredged material from a flood-control project, and Section 1103 addressing productive uses of dredged material on the upper Mississippi River. I must point out, however, that the jury is still out on the ultimate practicability of these proposals and/or the manner in which they will be implemented.

Beyond this rather safe observation, I can only provide some insight into how Civil Works dredging activities in general will be managed in the future as a result of this Act.

First, in evaluating all dredging projects authorized by the Act, we will apply as we have in the past what we refer to as our Federal Standards process and policy of selecting the least costly, environmentally acceptable disposal option for dredged material.

Second, the general tone of the Act and its provisions (e.g., Section 907, which requires that in project feasibility planning, benefits of environmental quality measures are at least equal to the costs) can be construed as offering general Congressional encouragement for the application of beneficial use concepts whenever practicable.

An early finding, if you will, from our joint habitat initiative with NMFS has been that the beneficial uses alternative is too often just simply not given thorough consideration in the planning process for our dredging projects. We are finding, however, that through the specific focus of this NMFS initiative on coastal habitat considerations, our respective field offices have identified some rather innovative and practical beneficial uses applications which have resulted in significant project cost reduction as well as increased efficiency in project management. We plan to implement this "lesson learned" into practice in our final revisions to the environmental compliance regulation for Federal dredging projects by encouraging full and equal consideration of the beneficial uses alternative in project planning.

Finally, the cost-sharing provisions and philosophy of this Act will have some significant and far-reaching impacts on the way the CE has traditionally managed its water resource programs. This provision is applicable to all Federally funded water resources development projects, not just to those related to navigation. Examples include Section 103, which requires cost-sharing for beach erosion control projects, except 100 percent of non-Federal funding required for privately owned shores with no public use. Section 602, which addresses lake restoration projects with 25-percent cost-sharing, and Section 704, which authorizes demonstration projects on fish and wildlife habitat development at 25-percent cost-sharing, are other examples.

With specific regard to navigation projects, the clear philosophy of this Act is that State and local governments are the project proponents, not

the CE or the Federal government. Because of the requirement for cost-sharing and within the framework of applicable Federal laws and regulations, we anticipate and certainly fully encourage a more active State and/or local role in project planning and decisionmaking on new project costs and specifications. This should include types of use and the extent to which beneficial uses of dredged material are incorporated.

This expanded level of project sponsor involvement will quite possibly also carry over into the regulatory arena. A question that is frequently asked of us is what good is a nice new Federal navigation project if the intended project purposes and benefits cannot be fully realized due to regulatory red tape? As this new law now requires that the project sponsor commit to a sizable investment up front, the sponsor will no doubt also have a great interest in ensuring that the intended project purposes and benefits are realized in a timely and environmentally responsible manner. It is quite likely that this cost-sharing provision will lead to a much greater attention up front on how best to accommodate all identifiable project disposal needs and that this in turn will lead to regional innovations in regulatory management.

We look forward to a partnership arrangement with the local and State governments in how to handle this material, how to share the burden, and how to reach a decision on what the best options are for use of the material. We are very sensitive to the local sponsor's input, particularly since they are paying part of the cost and they are going to help make the rules. We understand that, and we are anxious to work with the local sponsors to develop an equitable arrangement, in terms of the study timing, the study focus, and the design standards. We realize that some adjustments in our process are necessary to reflect the goals and standards of those who are "phasing" project construction. For example, in two cases of Baltimore and Norfolk improvement dredging, we are supporting the position of the States that project channel dimensions be provided consistent with a 12- to 15-year forecast of trade projections rather than the dimensions included in the design memo which projects benefits over a 50-year span.

This conference on beneficial uses can certainly go a long way to achieve all of the policy goals that we have established in the Assistant Secretary's office: efficient, effective decisions and wise use of Federal resources both environmentally and fiscally. As a reflection of the level of interest, up until about 2 years ago, the Office of the Assistant Secretary at the administration policy level really didn't even know that the beneficial uses issue existed. There was nobody on the staff that we assigned to monitor the issue. Mr. Robert Dawson (the Assistant Secretary) saw this as a critical issue, not only for the future of the CE, but for the future of sound environmental management. He assigned me to work with Bill Murden and other key officials in the CE and to make sure that the beneficial uses of dredged material issue gets the level of attention that it so rightly deserves. We are here to help.

INNOVATIVE USES OF DREDGED MATERIAL: OPENING REMARKS

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In this session, we will be talking about innovative uses of dredged material, and there've been quite a few of these in the Northeast. This is probably the first session where we are actually getting into contaminated dredged material. There are several beneficial use alternatives that will be discussed by our speakers, and they are applicable to both clean and contaminated material. These should be particularly important to us in the Northeast. We can put all types of dredged material to use, especially contaminated dredged material, but it requires innovative thinking and creative ideas.

Our first speaker is John Waffenschmidt with the New York City Department of Sanitation. John is responsible for their environmental compliance program related to dredging, permitting, and environmental analysis. He is going to tell us about a pilot project they are conducting in which they are dewatering dredged material and then using it for sanitary landfill.

Carol Coch is our second speaker. Carol works with me in New York District in the Water Quality Compliance Branch. Her background is in geology, and she is going to discuss a number of innovative uses going on in the New York District at the present time.

Our third speaker is Dr. Robert Cerrato, who is an assistant professor in the Marine Sciences Research Center at the State University of New York at Stony Brook. Dr. Cerrato is going to talk about another beneficial use that is near and dear to our hearts in New York District--subaqueous borrow pits. Dr. Cerrato has been working with benthic population changes and in the last several years has concentrated on the New York Bight area.

From down south in Mobile CE District, we have Pat Langan, who has been an engineer with Operations Division there for the past 15 years, although he has worked on special assignments with the Water Resources Support Center, Dredging Division (WRSC-D). Pat is going to talk about a project presently going on in Mobile Bay, underwater berms, otherwise known as Murden's Mounds! The only place underwater berms have been tried in the Northeast is in Norfolk District, but it certainly is a beneficial use that we will be watching for possible application farther north.

Our final speaker is Edward Marquand, a consulting engineer and senior associate with Trident Engineering Company, who has a very interesting and different approach to using dredged material. He makes firm foundations out of it. Ed has been involved with stabilization of problem dredged material for a number of years.

INNOVATIVE USES OF DREDGED MATERIAL: UPLAND DEWATERING OF DREDGED MATERIAL FOR THE CREATION OF LANDFILL COVER MATERIAL

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Introduction

The New York City waste disposal infrastructure utilizes a marine transfer system, maintained by the Department of Sanitation (DOS), as one of its critical components. The system begins with the nine marine transfer stations (MTS) located throughout the city, where waste is transferred from collection trucks to barges for shipment to the Fresh Kills Landfill. The MTS are crucial in that they reduce the need for garbage trucks to traverse the several boroughs of the city. Instead, the collection trucks drop their loads at the strategically located MTS and then return to their collection routes. This system reduces traffic impacts and truck travel time, resulting in reduced air and noise pollution as well as decreased operational costs for the city. With the reliance on essentially only one landfill in the southwest corner of the city, the importance of these MTS sites cannot be overemphasized.

A critical requirement in maintaining the MTS is routine dredging to maintain suitable navigable depths. The cost of performing this required dredging has increased considerably over the last few years due to environmental requirements imposed on the DOS by regulatory agencies; the DOS is presently paying from $10 to $40 a cubic yard to dredge and dispose of its dredged material at the ocean disposal site. These increased costs, in conjunction with increased regulatory difficulties, prompted the DOS to search for other mechanisms to deal with their dredging program. The decision to embark on an upland dredged material dewatering program was made to enable the DOS to use dewatered dredged material as landfill cover. This approach, if successful, would provide several benefits: (a) a solution to the DOS dredging problems, (b) a new source of landfill cover, (c) reduced truck traffic on Staten Island roads, and (d) a reduction in the volume of dredged material being disposed in the ocean. A reduction in landfill cover purchase requirements would be welcome since these costs have been escalating over the last few years. Presently, the DOS pays $8.25 per cubic yard for cover material. At a usage rate of 1.2 MCY per year, this is a substantial cost. The combined benefits of a full-scale dewatering program will result in considerable cost-savings as well as a reduction in the environmental impacts of the DOS operations.

Cost-savings are projected to result from reduced costs for dredging operations and a reduction in the cost of providing cover material for the landfill. For example, a preliminary cost comparison for a typical MTS, requiring 0.01 MCY, offers the potential for saving $115,000 from the dredging

operation and $40,000 on cover material costs, assuming a 50-percent volume reduction after dewatering. The true cost-savings would actually be lower, since some portion of the costs would have to offset the capital and operating costs of the dewatering facility. These costs would be dependent upon the dewatering strategy chosen.

Pilot Project Design

The design of the pilot project entailed the shore-term use of a carfloat to facilitate the transfer of dredged material from barges to the drying and disposal areas. Dredged material was deposited in four drying basins and two disposal areas. Surface water overflow and leachate from the basins enter a drainage ditch and are directed into a settling basin prior to discharge back into Little Fresh Kills. Figure 1 depicts the facility components.

Dredging was accomplished by use of a clamshell dredge which loaded the material directly onto barges. The barges were maneuvered to the carfloat area where a clamshell transferred the dredged material from the barge to DJB 25 cy off-road vehicles for transport to the appropriate disposal area or drying basin. Construction of the carfloat necessitated the dredging of about 1,000 cubic yards from the shoreline. This material was deposited in Disposal Area No. 1.

The four drying basins and the settling basin were lined with 36-mil Hypalon liner to allow for the quantification and analysis of any leachate that was generated. Each of the four drying basins was to employ a different dewatering technique to effectively evaluate the most environmentally and operationally sound method. The four test methods are as follows:

a. Dewatering by Evaporation. This system is akin to normal upland disposal and requires the longest time to yield suitable material. Three feet of dredged material was placed in the basin to be dried by evaporation. An expected shrinkage of 50 percent in volume would result in approximately 1.5 feet of dewatered material. This method is estimated to require about 1.5 drying seasons to yield suitable material.

b. Dewatering by Crust Management. This method required that 1 foot of dredged material be periodically bulldozed to expedite drying.

c. One-to-One Ratio Dewatering. This method required mixing one part dredged material with one part dry cover material and periodic bulldozing to expedite drying.

d. Three-to-One Ratio Dewatering. This method required mixing one part dredged material with three parts dry cover material and periodically bulldozing to expedite drying. The actual placement was at a 2.3:1 ratio.

Preliminary Operating Results

The pilot project design was based on a review of the available literature and the input of consultants, regulatory personnel, and DOS staff. The purpose of the pilot project was to experiment with different techniques and approaches to the problem and to modify the experiment based on data accumulated throughout the course of the project. That evaluation and experimentation are ongoing. Preliminary conclusions are as follows:

Unloading Techniques

Based on comments from regulatory agencies, a carfloat was used for unloading instead of constructing a full-scale unloading facility. The use of the carfloat resulted in an increased swing of the crane and precluded operating the off-road vehicles on a flow-through basis. Any full-scale facility, in order to be economically and effectively operated, will require that the barge be brought next to, and parallel to, the shoreline, and must provide for trucks to be brought through the facility on a flow-through basis.

Facility Size

The drying basins were each approximately 175 by 217 feet on berm centers. This size made operating any equipment extremely difficult in that the basins were too small to operate without extensive maneuvering of equipment. Even Disposal Area No. 1, at over 4 acres, appears to be too small to optimize equipment utilization. After additional evaluation of the equipment, an optimal facility size and configuration will be developed.

Equipment

Originally, the plan called for the use of small bulldozers for mixing and crust management. However, the bulldozers had difficulty operating in the dredged material and were not effective in crust management. In order to improve the operational effectiveness of deployed equipment, the use of sludge drying equipment was tried. Recent experiments included testing a rubber-tired Brown Bear with a 12-foot auger. The auger aerated the material while directing it to one side, thereby creating windrows. The windrows allowed more effective drainage of surface water and increased the evaporative effects of the wind. Preliminary results show that maximum average lift thickness for proper Bear operation appears to be about 1 foot.

Litter Removal

During unloading of the dredged material, an 8- by 8-inch grizzly was placed on top of the trucks for litter removal. The grizzly proved ineffective in that it was time-consuming to deploy and unduly hindered the placement of the material on the trucks. Prior to placement of the dewatered material on the landfill, the litter will be removed with a vibratory screen. The vibratory screen should allow the removal of enough material to use as cover material.

Drying Season

Spring 1987 has been characterized by low temperatures, high humidity, and above average rainfall. This has prompted a reevaluation of the maximum drying season during which equipment should be deployed. Consideration is being given to narrowing the period of material manipulation to very late spring/summer months.

Environmental and Regulatory Factors

The small size of the pilot project will preclude any significant environmental impacts or benefits. If the pilot project experiment proves successful, a number of benefits are expected with subsequent scaleup to a full-scale dewatering facility. Specifically, the volume of dredged material entering the dewatering facility would result in a like volume of savings at the ocean disposal site. By using dewatered dredged material for landfill cover, the overall cover material trucking distances will be reduced, resulting in decreased air and noise pollution, reduced fuel consumption and congestion, a reduction in wear and tear to city streets, and reduced DOS costs. If the DOS scales up to 0.2 to 0.3 MCY per year, which would produce 0.1 to 0.2 MCY of cover material, up to 5,000 trucks per year would be removed from Staten Island roads.

An important component is the monitoring of chemical constituents in the surface water runoff and leachate. As mentioned previously, the drying basins were fully lined to enable a complete evaluation of leachate quantities and constituents. An underdrainage system for the collection and characterization of the leachate, composed of perforated pipe wrapped in filter fabric, was placed in cushion sand. To allow flow quantification and evaluation of the leachate's chemical constituents, gate valves were placed in a sump prior to discharge into a drainage ditch.

The outfall from Disposal Area No. 1 was tested for Classical State Pollution Discharge Elimination System (SPDES) requirements utilizing one 6-hour composite sample. The test results in reference to permit requirements are provided below:

Test	Permit Requirement	Result 12/30/86	Result 2/26/87	Result 4/28/87
BOD5	50 mg/ℓ	26 mg/ℓ	40 mg/ℓ	--
pH	6.0-9.0	6.8	6.95	7.5
TSS	50 mg/ℓ	75 mg/ℓ	220 mg/ℓ	32 mg/ℓ
COD	monitoring only	98 mg/ℓ	110 mg/ℓ	40 mg/ℓ

The only violation at this location during the first two test dates was for total suspended solids (TSS). This was due not to the dredged material but to the Staten Island clay that was used to construct the dewatering site. To rectify this, a drainage course consisting of a 6-inch bed of 0.75-inch stone and three barriers of 0.75-inch stone, sand, and pea gravel with filter fabric placed between each barrier was established. The test results for April 28 demonstrated the effectiveness of the drainage course.

On 23 December 1986, the leachate from the natural drying basin was sampled for a number of chemical constituents. A comparison of the test results with the applicable standards and with the results of the sediment and site water testing previously undertaken is provided in Table 1. Note that the test results substantiate the hypothesis that leachate quality is directly related to sediment and site water conditions. This suggests that potential leachate constituents can be predicted based on the appropriate sediment and site water tests and that applicability for upland disposal can be determined based on these types of tests.

To develop a full-scale facility, a number of environmental permits and approvals are required, and several regulatory issues require resolution. The CE is a proponent of upland disposal and dewatering in that their regulations (40 C.F.R., Part 227, Subpart C; Need for Ocean Dumping) specifically mandate them to allow dredged material to go to the ocean only as a last resort for dredged material disposal. As a result, their permitting role is relatively minor for upland dewatering. The CE position has resulted in the New York Department of Environmental Conservation (DEC) becoming the major permitting agency. Since this is a new responsibility for DEC, DOS and DEC are coordinating to develop an appropriate regulatory relationship. It is expected that the DEC will develop sediment and site water testing requirements so that dredged material can be evaluated in place as to its acceptability for dewatering and use as landfill cover material. Based on the test presently required for ocean disposal, any material presently suitable for ocean dumping should also be suitable for upland dewatering.

The DEC has stated that only minimal amounts of litter will be allowed in the cover material and is regulated under New York regulations, GNYCRR Part 360.1(d)(14). That section defines suitable cover as "soil and/or other suitable material acceptable to the department." The DOS recognizes that it is not possible to remove all litter from dredged material and believes that a reasonable amount of litter should be acceptable. If the amount of litter is low enough to enable the material to provide the functional aspects of cover, then it should be acceptable to the DEC.

During the pilot project, DEC subjected discharges from the facility to the SPDES permitting requirements, pending additional review and consideration by the DEC. SPDES permitting authority is embodied in Parts 750-758 of 6 NYCRR. DOS dewatering outfalls were built for storm water discharge and not for the discharge of process waters. The application of SPDES to the pilot project is one of the first cases of regulating storm water runoff in New York. To properly do this, it is necessary to abandon the concept that such discharges are subject to the same requirements as for wastewater discharges. A necessary regulatory consideration must be that the flows are intermittent and that the effluent characteristics will be determined in part by rainfall intensity. Any permitting strategy for storm water outfalls, in general, must be based on a realistic assessment of the environmental impacts associated with such discharges and on regulatory efficiency in the administration of such a program.

The DEC's requirement that the dewatering facility basins be lined during the pilot project presumes that they are considering applying groundwater standards to upland dewatering. Part 703 of 6 NYCRR provides the

regulatory basis for jurisdiction over ground water. At present, all ground waters in New York are considered either acceptable for a potable water supply (GA) or waters which have potable minerals (GSA). Another category, saline waters suitable for the disposal of wastes (GSB) has not yet been designated in New York. GSB water standards could be applied at a later date.

Acknowledgments

This pilot project and experiment could not have been carried out without the involvement of a number of DOS personnel. Assistant Commissioner Anthony Zarillo provided constant advice and support throughout all project phases. Phillip J. Gleason, the Director of Landfill Engineering, offered advice and moral support, and Mike Balarezo and Jim Wilson, project managers, were tireless in their efforts to improve the process and make upland dewatering for landfill cover a reality in New York City.

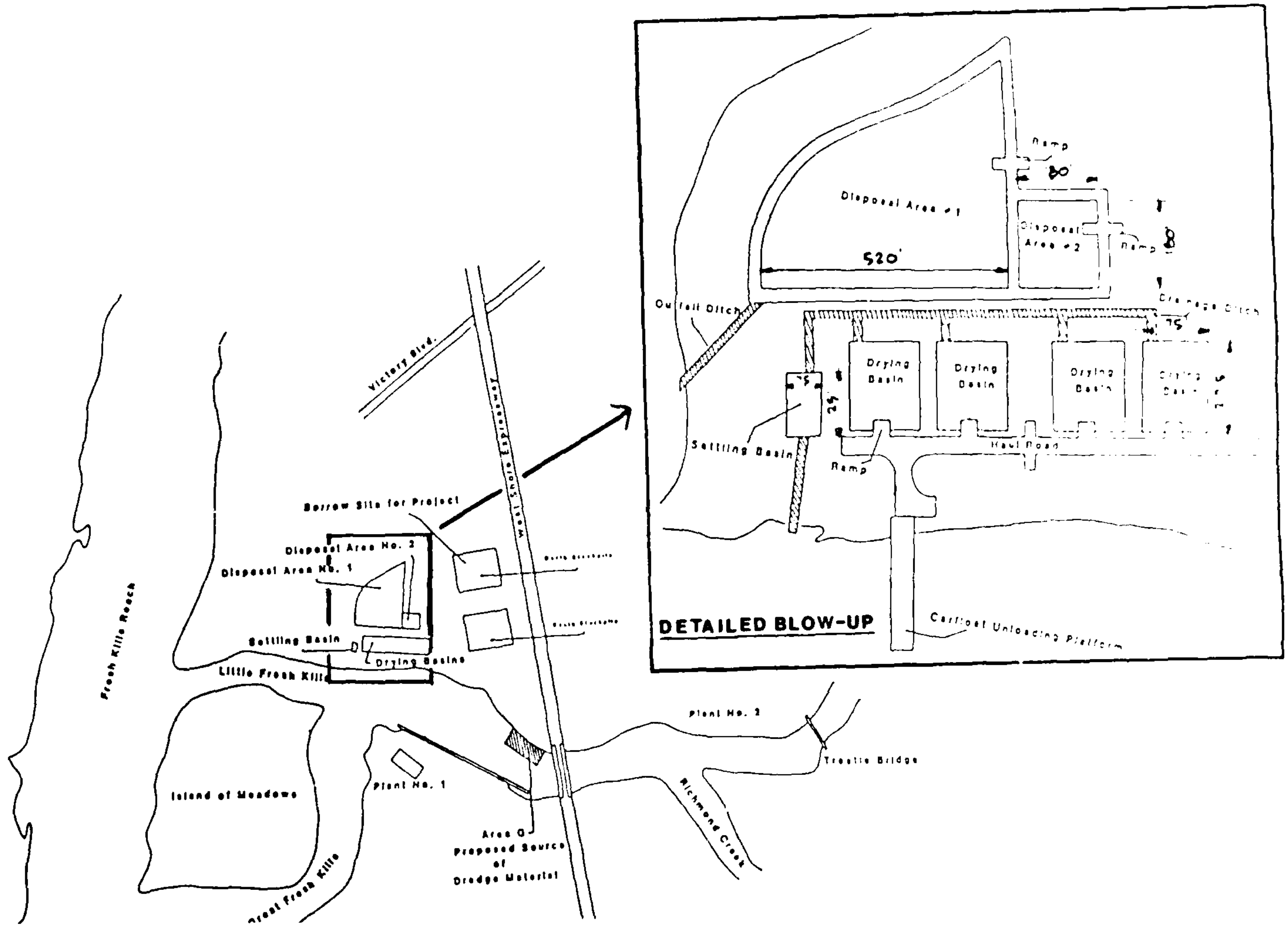

Figure 1. The pilot project dewatering facility location, Fresh Kills, Staten Island, New York City

Table 1

Comparison of Test Results with Applicable Standards and with Results of the Sediment and Site Water Testing Previously Undertaken for the Area G Dredged Material

Test	Applicable Standard mg/ℓ	Natural Drying Basin Leachate Test Results mg/ℓ	Area G Elutriate mg/ℓ	Site Water mg/ℓ	Total Composite E.P. Toxicity Leachate Area G mg/ℓ	Total Composite Area G mg/kg-dry wt
Alkalinity (as $CaCo_3$)	-	390	120	120	-	400
Ammonia - N	-	0.6	3.4	3.6	-	52
BOD_5	-	2	<4	<3	-	-
Color (units)	-	30	15	75	-	-
Cyanide (total)	-	<0.03	-	-	-	<1
Nitrate - N	-	0.39	0.67	0.99	-	63
Nitrogen - Kjeldahl	-	1.7	5.3	5	-	480
Petroleum hydrocarbons	-	<1	<1	<1	-	430
pH (units)	-	6.8	7.6	7.5	-	7.8
Phenols (totals)	-	<0.002	-	-	-	0.29
Specific conductance (μmhos)	-	3,200	19,500	17,900	-	-
Surfactants	-	<0.03	0.18	0.22	-	-
TOC	-	11	15	8	-	1,900
Boron	-	0.27	3.3	4.2	-	110

(Continued)

NOTE: Pesticides and PCB compounds (by GC) = all nondetectable.
Base neutral compounds (by GC/MS) = all nondetectable except total composite = 3 ppm Bis(2-Ethylhexyl) Phthalate
Purgeable organic compounds (by GC/MS) = all nondetectable except total composite = 0.2 ppm Methylene chloride; site water = 8,900 ppb Methylene chloride; Area G elutriate 1,600 ppb Methylene chloride.
Acid extractable compounds (by GC/MS) = all nondetectable.

(Sheet 1 of 3)

Table 1 (Continued)

Test	Applicable Standard mg/ℓ	Natural Drying Basin Leachate Test Results mg/ℓ	Area G Elutriate mg/ℓ	Site Water mg/ℓ	Total Composite E.P. Toxicity Leachate Area G mg/ℓ	Total Composite Area G mg/kg-dry wt
Chloride	-	1,200	10,000	10,000	-	3,500
COD	-	32	71	120	-	-
Hardness (as $CaCo_3$)	-	1,600	2,900	2,600	-	-
Sulfate	-	15	1,300	1,400	-	580
Total dissolved solids	-	3,100	16,200	14,000	-	-
Total volatile solids	-	600	-	-	-	-
Odor	-	ND	ND	ND	-	1.4%
Percent solids	-	-	-	-	-	75
E. P. TOXICITY						(not E. P. Tox.)
Arsenic	5.0	<0.01	0.03	0.02	<0.01	9.2
Barium	100.0	0.47	0.007	0.012	0.25	-
Cadmium	1.0	<0.0006	<0.005	<0.005	<0.005	1.1
Chromium	5.0	<0.008	<0.005	<0.005	<0.005	24
Lead	5.0	<0.003	<0.025	<0.025	<0.025	40
Mercury	0.2	<0.0002	<0.002	<0.002	<0.002	0.15
Selenium	1.0	<0.01	0.028	0.03	<0.01	<0.7
Silver	5.0	<0.01	<0.01	<0.01	<0.01	0.39
Endrin	0.02	<0.01	<0.01	<0.01	<0.01	-
Lindane	0.4	<0.01	<0.01	<0.01	<0.01	-
Methoxychlor	10.0	<0.01	<0.01	<0.01	<0.01	-
Toxaphene	0.5	<0.01	<0.01	<0.01	<0.01	-
2,4-D	10.0	<0.01	<0.01	<0.01	<0.01	-
2,4,5-TP	1.0	<0.01	<0.01	<0.01	<0.01	-

(Continued)

(Sheet 2 of 3)

Table 1 (Concluded)

Test	Applicable Standard mg/ℓ	Natural Drying Basin Leachate Test Results mg/ℓ	Area G Elutriate mg/ℓ	Site Water mg/ℓ	Total Composite E.P. Toxicity Leachate Area G mg/ℓ	Total Composite Area G mg/kg-dry wt
Aluminum	-	<0.03	<0.01	0.56	-	9,400
Antimony	-	<0.02	<0.05	<0.05	-	<2
Beryllium	-	<0.0009	<0.002	<0.002	-	0.24
Calcium	-	480	110	82	-	690
Copper	-	0.11	<0.003	0.02	-	42
Iron	-	1.1	0.39	2.9	-	8,700
Manganese	-	9.0	0.15	0.14	-	140
Nickel	-	0.04	0.01	0.02	-	11
Sodium	-	560	2,800	2,700	-	2,100
Thallium	-	<0.009	<0.03	<0.03	-	<1
Zinc	-	-	<0.02	<0.06	-	130

(Sheet 3 of 3)

INNOVATIVE USES OF DREDGED MATERIAL: CAPPING AS A MANAGEMENT TECHNIQUE FOR OCEAN DISPOSAL OF DREDGED MATERIAL

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More than 90 percent of the 6 MCY of material dredged annually from the New York/New Jersey (NY/NJ) Harbor is slated for ocean disposal. The Mud Dump Site is 1 by 2 nautical miles in size and is located approximately 12 miles southeast of Rockaway, New York, and 6 miles east of Sandy Hook, New Jersey (Figure 1). Disposal has occurred in this vicinity since 1914. In 1984 the present site was designated by its EPA for a maximum capacity of 100 MCY, which should last approximately 10 years. The four quadrants of the Mud Dump Site have various purposes: (a) the northeast is used for current disposal, (b) the northwest is restricted due to shoaling, (c) the southeast has been used for experimental sand capping (ESC), and (d) the southwest will be used when the other quadrants are filled.

Approximately 5 percent of the Harbor dredged material is unsuitable for unrestricted ocean disposal and requires capping as a mitigative measure. Clean dredged material is used as a cap for the unsuitable material to ensure that contaminants are isolated from the marine environment. Capping is considered a beneficial use of dredged material because it allows environmentally sound disposal of moderately contaminated dredged material for which there is no present disposal alternative. Capping has been extensively studied by New York CE District (NYD) as part of the Disposal Management Plan for the Port of New York and New Jersey, which includes research on continued ocean disposal, management of the Mud Dump Site, and new work disposal and capping at the experimental Mud Dump Site (EMD). Feasibility studies have been conducted on the following alternatives: subaqueous borrow pits, containment islands and areas, wetland stabilization areas, regional upland disposal sites, and use of dredged material as sanitary landfill cover. Two of these alternatives, ocean disposal and subaqueous borrow pits, potentially involve capping.

This paper will discuss present ocean disposal management practices using capping, previous capping studies, results of recent surveys at the Mud Dump Site and the EMD, management of the Mud Dump Site as envisioned in a draft Memorandum of Understanding (MOU) between the CE and EPA, a management plan for large volume disposal of material to be capped from the Kill van Kull/Newark Bay Deepening Project, and the possible effects of P. L. 99-662 on the future of capping/management in the District.

Previous Studies

Capping of contaminated dredged material containing heavy metals such as mercury, cadmium, and lead, and organic compounds such as petroleum hydrocarbons and PCBs with relatively uncontaminated sands and silt has been

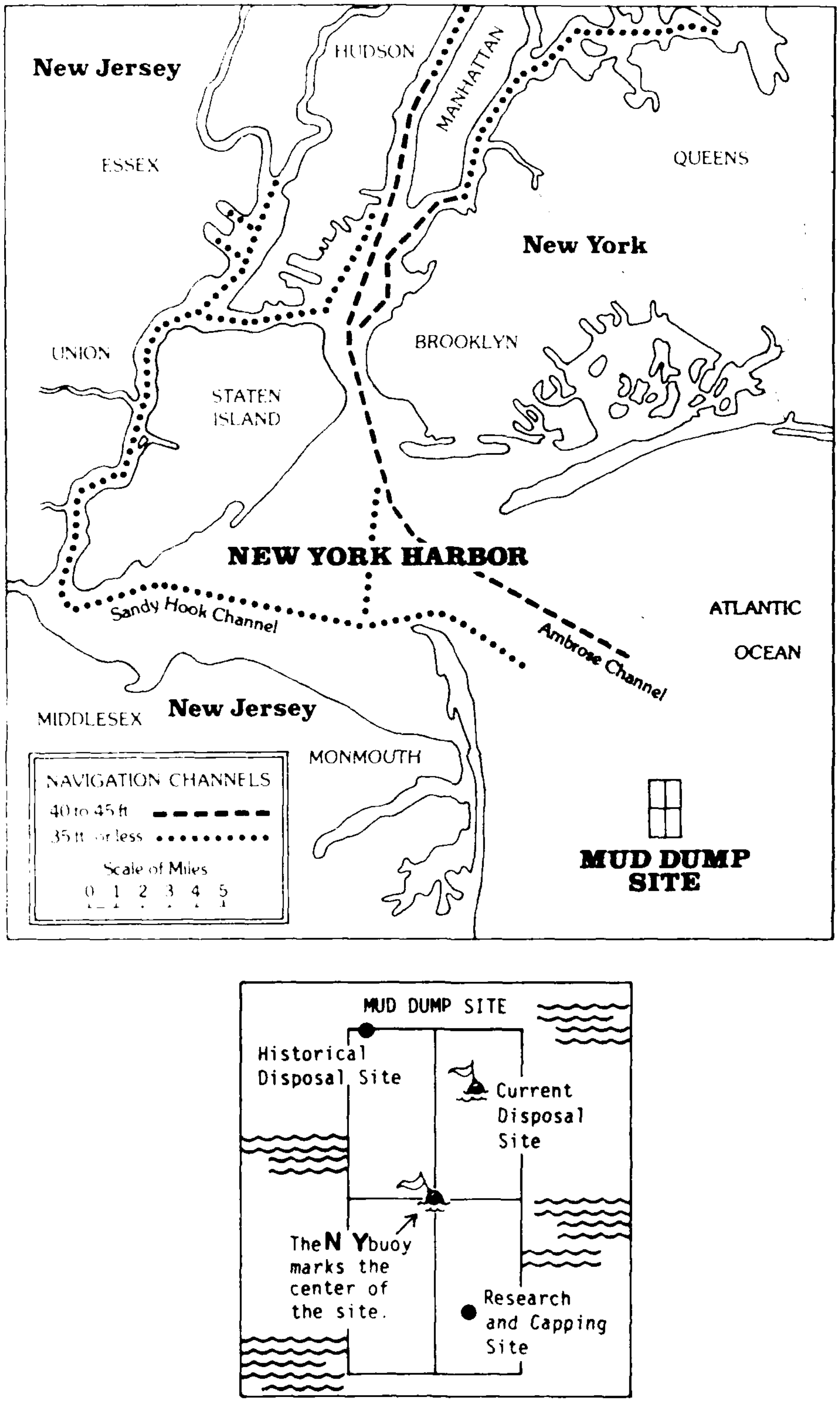


Figure 1. Location of the Mud Dump Site

been extensively studied by the Japanese and by the US Army Corps of Engineers in the New England Division (NED), the NYD, and WES.

Japanese researchers have reported several capping studies in proceedings of the US/Japan Experts Meetings. Capping in Hiroshima Harbor effectively reduced nutrient release from underlying sediments (Takata 1981). Capping using a thin layer of clean sand to control phosphate release allowed more efficient covering (Kuroda and Fujita 1981).

Aspects of the NED Disposal Area Monitoring System (DAMOS) emphasized capping operations (Andreliunas 1982). Capping studies have been conducted under the DAMOS at Central Long Island Sound (CLIS), Stamford-New Haven, and Norwalk disposal sites. The effectiveness of sand versus silt as capping material was shown at the Stamford-New Haven sites (Morton 1980a and 1980b, Semonian 1981). The silt cap underwent severe erosion during Hurricane David in 1980 (Morton and Karp 1980).

The results of the 1980-1981 DAMOS studies were: (a) cap material could effectively be emplaced at a taut-moored buoy, (b) sand was less likely to erode under hurricane conditions than silt, (c) both textures of material were stable under normal conditions, (d) irregular surfaces on silt caps eroded more easily than smooth surfaces, and (e) benthic organisms populated the site within 1 year of emplacement of the cap. Studies at the Norwalk site showed that capping was most effective when cohesion of the material was maintained during disposal. the cap surface area was minimized, and the cap surface was smooth (Morton 1981). NED has continued to monitor capping at their disposal sites through the DAMOS and has produced 55 reports to date. The latest report includes a post-Hurricane Gloria bathymetric survey of the site which showed widespread small-scale (0 to 8 inches) disturbances but overall stability of the three major disposal mounds.

NYD initiated the New York Bight Capping Project in 1980 to determine whether capping was a viable management technique. Numerous physical, chemical, and biological tests were conducted in association with experimental capping at EMD. This pilot project was done to determine the effectiveness of isolating contaminated material with a cap of clean material. Results were presented by Suszkowski and Mansky (1981), Suszkowski (1981), Mansky (1982), and Coch et al. (1983). Approximately 0.52 MCY of fine-grained, contaminated material from New York Harbor was precisely dumped at a taut-moored buoy at the EMD in June 1980. The contaminated material was capped with approximately 0.19 MCY of less contaminated material in August 1980. The entire EMD was capped with 1.1 MCY of clean, fine-to-coarse sand from Ambrose Channel, varying from 20 to 62 inches deep.

O'Connor and O'Connor (1983) summarized the capping studies conducted at the EMD:

a. A sediment cap stability study was conducted to characterize the surficial sediments of the cap over a 1-year period, together with measurements of threshold velocities for sediment erosion and physical parameters which affect cap stability (Freeland et al. 1983). The sand cap was found to be stable under normal weather conditions.

b. A bioaccumulation study showed that mussels at the EMD did not bioaccumulate higher levels of contaminants of concern than those mussels at a control site (Koepp et al. 1982).

c. A chemical signature study was conducted which showed that contaminant levels in the sand cap, as compared with the capped material, were greatly reduced. Therefore, contact of the contaminants with the water column was also greatly reduced (New York University Medical Center 1982).

d. A study using predictive models, bathymetric surveys, and sediment cores indicated that the presence of the cap at the EMD reduced contaminant food chain levels in the water column and in the marine environment (Dayal et al. 1981).

e. A sediment budget study estimated the amount of contaminated dredged material which could be dispersed into the environment during dredging and dredged material disposal operations (Tavolaro 1984). The study found that less than 4 percent by weight of dredged material was dispersed during the disposal operation.

Further monitoring of the cap in 1983 indicated that it had remained relatively stable, but that minor erosional losses had occurred due to average weather and sea conditions (O'Connor and Moses 1984). This study found the cap to be resistant to forces exerted by major storms and found that little or no migration of heavy metals had occurred through the cap throughout a 2.5-year time period.

Capping has also been successfully used in other CE Districts, for example, on the Duwamish Waterway in Seattle District and in the NED (Sumeri 1984). WES summarized available information on survey equipment and construction techniques for capping (Sanderson and McKnight 1986). WES has also distributed two technical notes which include existing capping data and techniques (Truitt 1987a, 1987b) and two technical reports detailing capping studies (Montgomery 1984, Shields and Montgomery 1984).

In summary, these capping studies have shown that capping can be performed effectively in the New York Bight. Placement of a cap over accurately placed (pinpoint dumped) contaminated dredged material has been shown to rapidly render the contaminants harmless to the marine environment. Less than 4 percent of the capped material was lost during disposal. The cap was found to stay in place under normal conditions at the EMD, and it acted as a barrier to prevent bioaccumulation. NYD has used the aforementioned studies to develop and carry out management strategies for the Mud Dump and EMD sites.

Present NYD Capping Management Practices

The overview of previous modeling and monitoring studies showed that capping is an effective management tool for isolating contaminated material and that only 3.7 percent of the material is transported from the site. As a result, capping has been accepted as an alternative by an Interagency Steering Committee consisting of EPA, CE, NMFS, and FWS. Only FWS has

expressed reservations concerning capping and is still evaluating its long-term use. It has concurred, however, on a case-by-case basis. Port management now includes capping as an integral part of its dredging program.

The NYD's management strategy has been to identify projects requiring capping, and those which could be used as cap material, through bioassay and bioaccumulation testing. Capping was integrated into the management strategy for the Mud Dump Site when it was designated by EPA in 1984. The site was set up in quadrants, and the disposal operations were carried out as planned. Sequential capping and de facto capping of dredged material using point dumping at the taut-moored buoy in the northeast quadrant was carried out (Figure 2). Sequential capping consists of disposal of contaminated material from a private source or Federal project by point dumping, followed by point capping with clean material within a 2-week period (Figure 3). De facto capping consists of point dumping of contaminated material followed by capping during the next project or projects with clean dredged material (usually within 1 month). The type of capping selected usually depends upon the degree of contamination, availability of capping material, and the dredging schedule. Benthic organisms do not have time to colonize highly contaminated material within a 2-week time period when sequential capping is used. Capping is closely coordinated by NYD through permits issued for private dredging.

The selection of the cap material and the ratio of capped material to cap volume are determined on a case-by-case basis. The cap itself can consist of a broad range of grain sizes. A ratio of 1:2 dredged material to capping material is commonly used, although 1:1 and 1:4 have also been used. Dredged material from the NY/NJ Harbor is always disposed at the northeast buoy to limit the potential area which could be affected by contaminants released from the material. Alternating dredged material with capping material results in de facto capping for the entire northeast quadrant of the Mud Dump Site.

Projects capped to date have been mostly by private applicants. These projects were located in industrial port areas and include: (a) the NY/NJ Port Authority (Port) marine terminal in Newark Bay, (b) the Pierhead Channel, (c) Port Elizabeth, (d) the Port passenger ship terminal in the Hudson River, (e) several facilities in the Kill Van Kull area, (f) two facilities in the East River, (g) two facilities in the Passaic River, and (h) two facilities in the Hudson River at Stony Point and Westchester County (Figure 4).

The volume of capping material, material capped, and total dredged material disposal is shown for calendar years 1980-1986 in Figure 5. No sequential capping occurred in 1986, although some projects were de facto capped. The total volume being capped was approximately 1.7 MCY, and the total volume of capping material was 3.8 MCY. Capped material makes up approximately 5.6 percent of the total annual dredging from all sources of 30 MCY.

Comparison of the capped material, cap, and total dredged material is shown graphically in Figure 6. Total Federal dredging from 1980-1983 was considerably less than the previous 10-year average of 8 to 10 MCY annually. This decrease was primarily due to a reaction to the passage of several laws addressing the environmental impacts of disposal. In 1986, the decrease in disposal was a result of scheduling, rather than any trend toward an overall decrease in disposal needs. In fact, several large projects will require

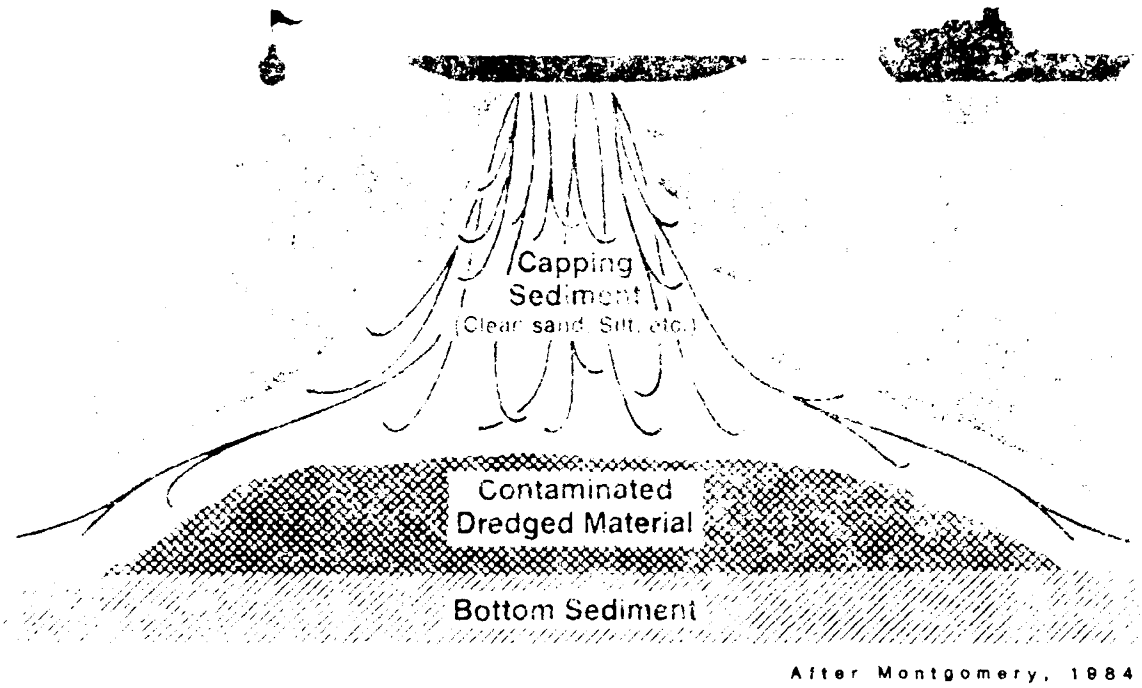


Figure 2. Schematic of typical capping operation

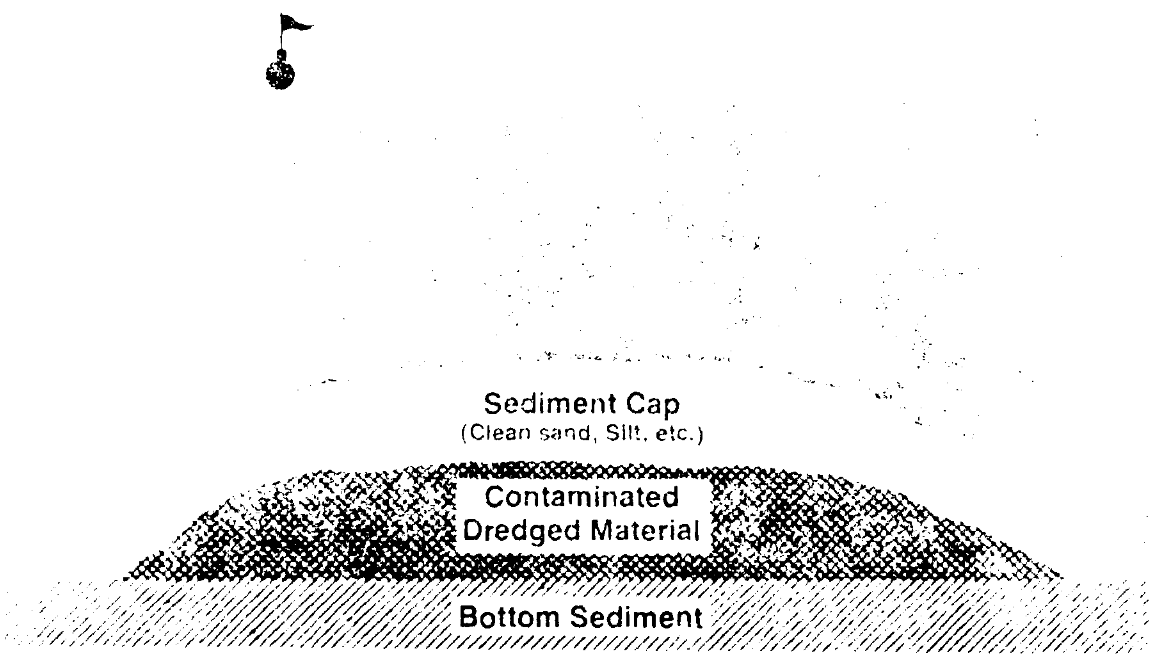


Figure 3. Schematic of typical cap and mound

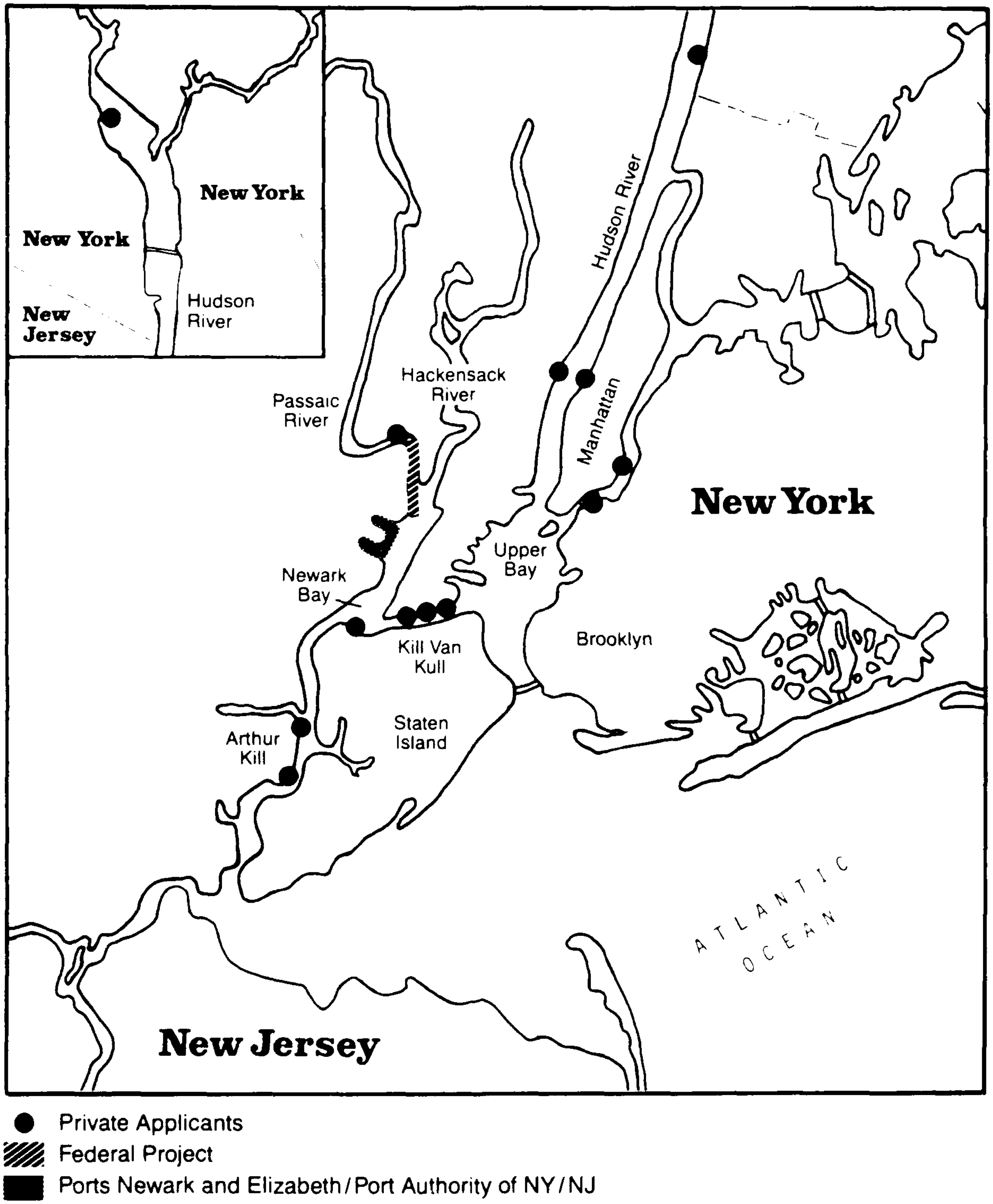


Figure 4. Material that requires capping from NY/NJ Harbor area (1980-1985)

CAPPING AT MUD DUMP SITE
CUBIC YARDS

Year	Capped Material	Cap	Total O&M
1980	838,760	2,002,045	3,452,469
1981	68,600	159,400	2,331,109
1982	37,200	429,300	4,365,032
1983	702,400	749,000	4,162,842
1984	7,200	402,200	7,203,122
1985	41,400	41,400	5,525,609
1986	0	0	3,016,866
Totals	1,695,560	3,783,345	30,057,049

Figure 5. Capping at Mud Dump Site in cubic yards

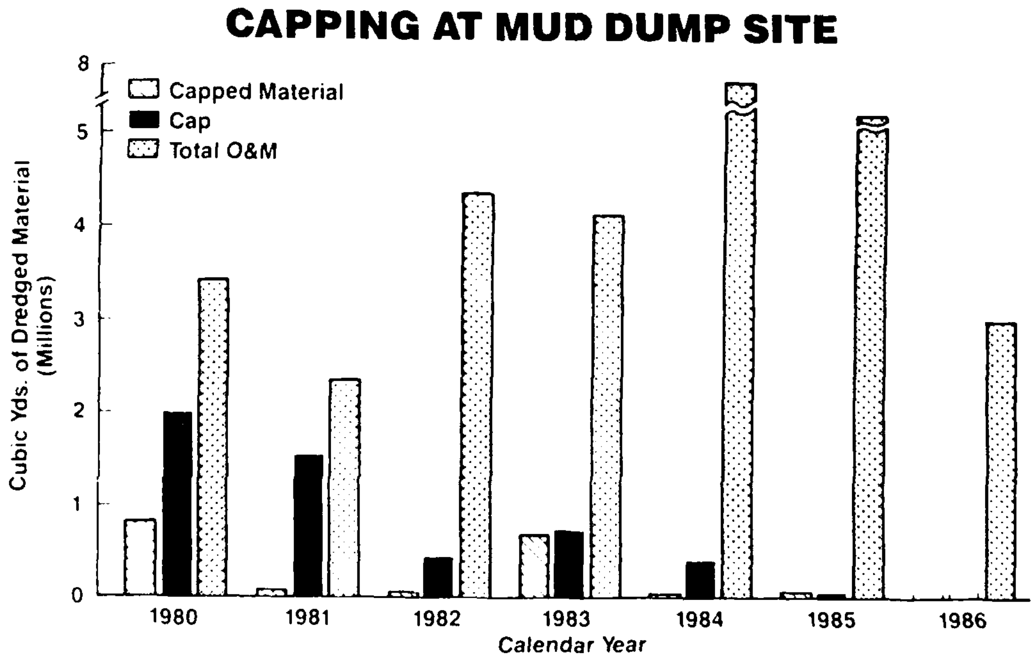


Figure 6. Capping at Mud Dump Site over time

45 MCY of ocean disposal during the next decade. Estimates of future maintenance dredging average 6 to 7 MCY annually.

Sequential capping always exceeded capped material each year. In addition, the remaining maintenance material acted as a de facto cap at the Mud Dump Site. In some cases, individual projects contained both suitable material for capping and the contaminated material. An example of this is the GATX Terminals project dredged in 1985, where a 1:1 ratio was used.

By December 1986, over 3 MCY had been deposited at the Mud Dump Site since the last capping took place (July 1985). This has formed a mound 16.1 feet high, with a 2,400-foot radius. This mound has formed an effective de factor cap for that quadrant.

Memorandum of Understanding Between EPA Region II and NYD

EPA's Region II and NYD have developed an MOU on management and monitoring of ocean disposal and designation of ocean disposal sites. The authority for the MOU originated from the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) as amended (33 CFR Part 324), and the national MOU between EPA and the CE. Both MOUs are in draft form, and are expected to be finalized in the near future. The national MOU authorized CE Districts and EPA Regions to enter into localized MOU's. Under Section 102 of MPRSA, EPA has veto power over CE ocean disposal permits, and EPA has the responsibility to designate new ocean disposal sites as needed (40 CFR Part 228). Under Section 103 of MPRSA, the CE is responsible for testing dredged material, and under 33 CFR Part 324, the CE is responsible for regulating the transport of dredged material for ocean disposal. The purpose of the regional MOU is to promote cooperation and to share responsibilities between the two agencies for management and monitoring of the Mud Dump Site, permit processing and review, sediment testing and evaluation, and designation of new ocean disposal sites.

NYD and EPA update and reevaluate their bioassay and bioaccumulation testing procedures as needed. NYD evaluates the results of the tests as part of their permit process. In conjunction with EPA and other agencies, the NYD makes recommendations regarding appropriate measures for disposal such as unrestricted ocean disposal or restricted disposal with capping as mitigation. These recommendations are based on comparisons of test results with average permitted values (a matrix) for contaminants of concern. NYD and EPA coordinate quality control and assurance with EPA's Edison, New Jersey, Laboratory, which includes conducting laboratory inspections, providing performance evaluation samples, and conducting laboratory performance reviews. Long-term monitoring of ocean disposal will be performed at the Mud Dump Site, and results will be used to update the contaminant values matrix. This would allow unrestricted disposal, provided that test values do not exceed ambient levels and no further water quality degradation occurs. If ambient levels are naturally changed, the matrix values would be adjusted accordingly.

Study alternatives in the Port management plan will continue to be explored and implemented by NYD when feasible. Site designation responsibilities are also considered in the MOU, with EPA the lead agency and NYD a cooperating agency. Site selection is based on consideration of numerous pertinent factors and, once selected, will be formally designated by the EPA. Both agencies have agreed to maximize their available resources and to keep time frames to a minimum.

Current Capping Studies at the Mud Dump Site

Monitoring at the Mud Dump Site was funded by NYD, with particular attention to cap stability at the EMD. Science Applications International, Newport, Rhode Island, conducted the study, where bathymetric, sediment, and benthic analyses were performed to determine whether point dumping has been effective and whether the cap has remained intact after severe storm conditions such as that inflicted by Hurricane Gloria. WES has been involved in these studies, and under its Long-Term Effects of Dredging Operations Program (LEDO). Details of monitoring techniques are available from the WES and from NYD.

Microscale sampling at the site included a precision bathymetric survey of the EMD (Figure 7) and used the same sampling stations as a 1981 NYD survey of the same area. A 2,050 by 3,700-yard area, using a 50-yard lane, was covered, and a REMOTS grid at a 400-yard spacing was used to define the boundaries of the EMD. Due to unfavorable weather conditions during sampling, research efforts were concentrated on the EMD. Less coverage was obtained in the northeast quadrant where dumping is continuing at the present time.

A microscale survey was conducted in the EMD in a 1,200 by 2,000-yard area, using a lane spacing of 25 yards (Figure 8). This was the same spacing used by NYD in 1980 and 1981 surveys. Subbottom profiling with a 50-yard spacing was conducted at the same location to determine cap thickness and possible breaching areas. The lateral extent of the cap and the dredged material was measured by REMOTS images, complete analyses of which will produce benthic process maps of the cap and outline areas of erosion and deposition. The REMOTS images will also be used to determine recolonization levels of benthos at the site. A draft report which will include the REMOTS data will be completed in 1987.

The 1981 survey was of the location in the northwest quadrant which had been shoaling due to historic dumping (Figure 9), and this area is currently use-restricted. This survey indicated significant dumping near the buoy in the northeast quadrant and the sand cap in the EMD. By contrast, the 1986 survey indicated considerable accumulation of dredged material centered around the location of the northeast buoy (Figure 10). The depth of the mound in 1986 was approximately 45 feet. However, the two surveys showed marked agreement in configuration and depth, especially at the EMD. The cap has remained relatively constant over a 7-year time period.

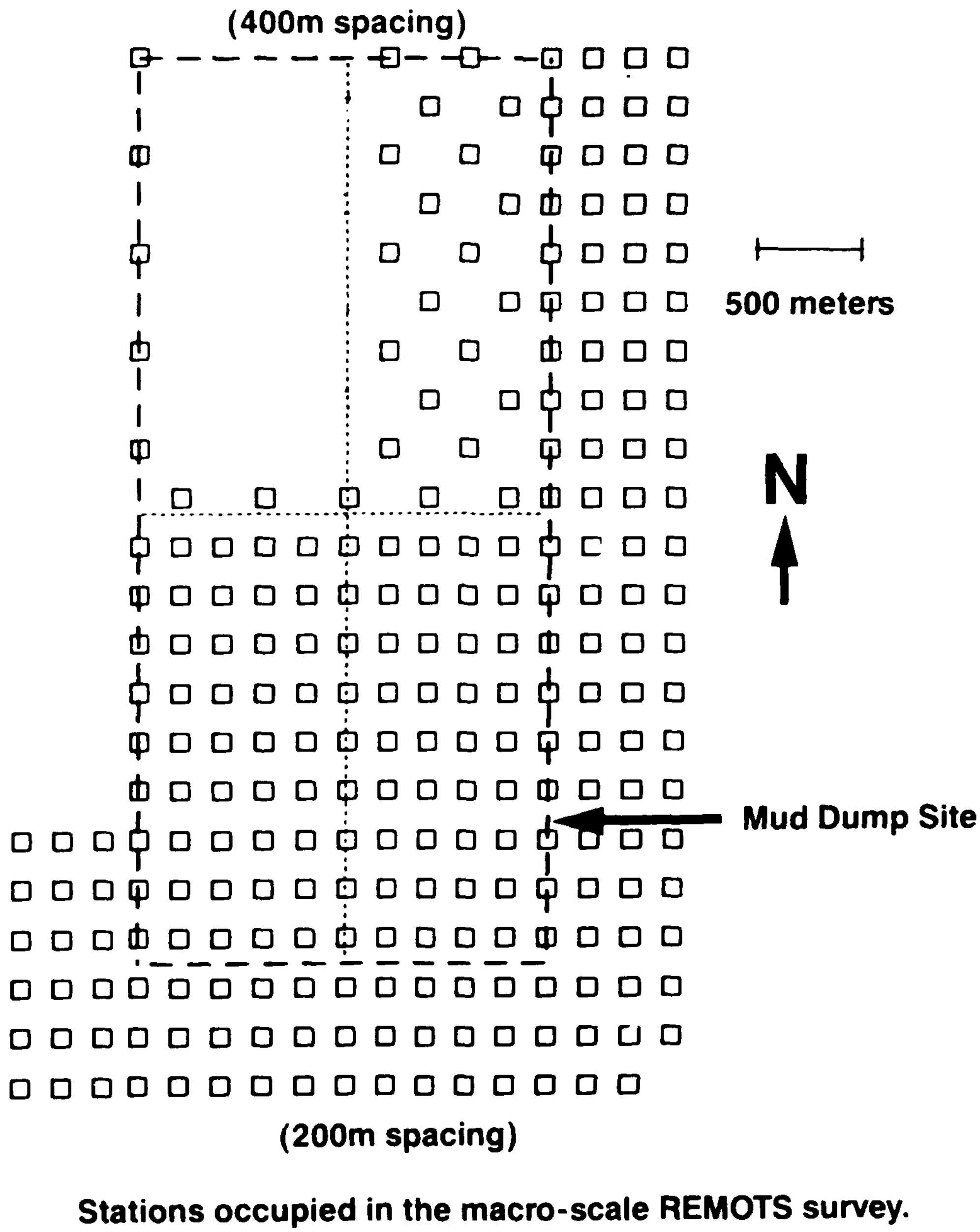
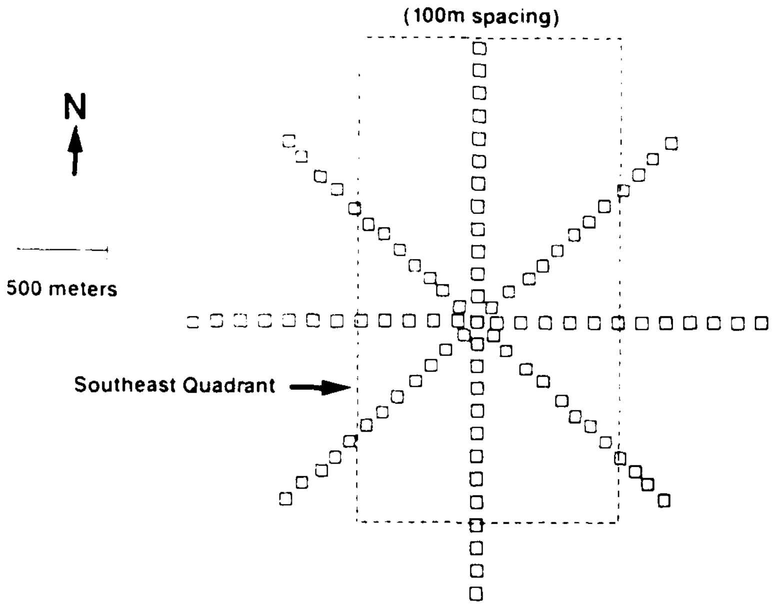


Figure 7. Macroscale REMOTS survey



Station locations for the microscale REMOTS survey.

Figure 8. Microscale REMOTS survey

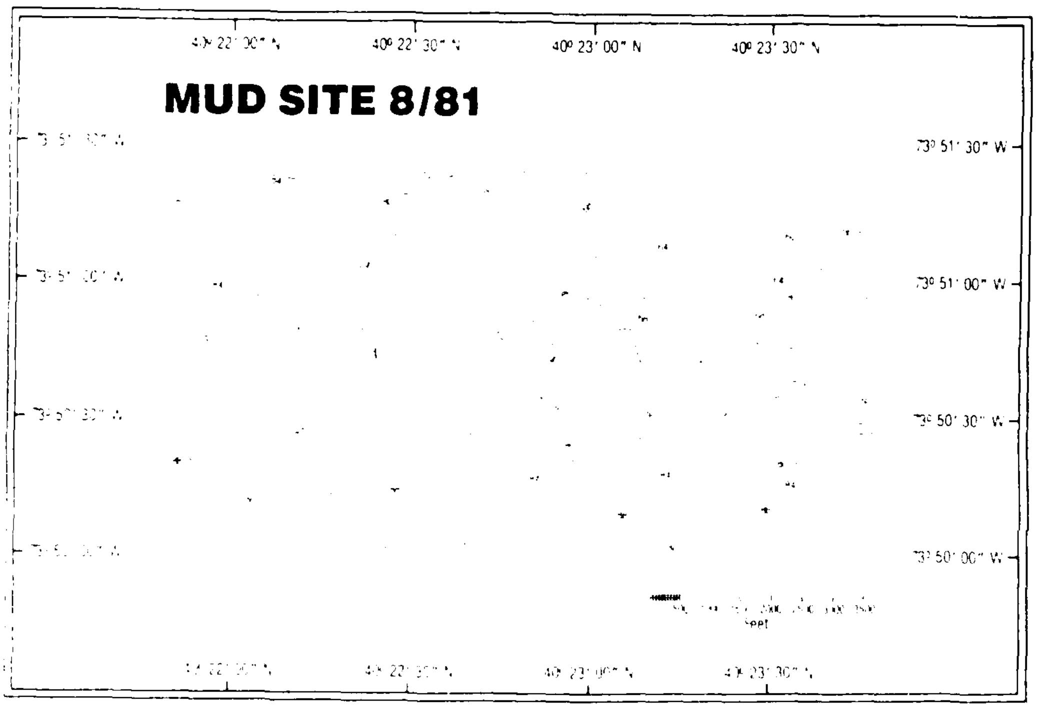


Figure 9. Mud Dump Site in August 1981

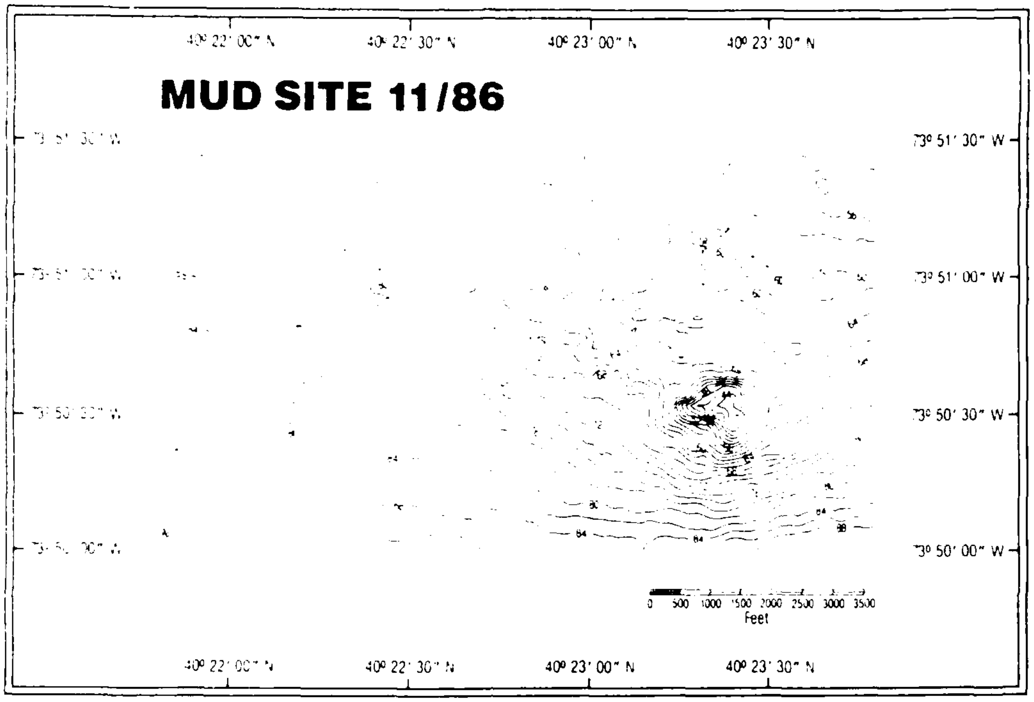


Figure 10. Mud Dump Site in November 1986

A three-dimensional (3-D) relief grid indicates that point dumping and capping have accurately and precisely placed maintenance and new work material at the buoy in the northeast quadrant (Figure 11). Sequential and de factor capping have combined to create the mound shown in the figure. Three MCY of capping material has formed a mound 16 feet high and 4,400 feet in diameter since January 1986. Fine-grained sediment found at the surface of the cap is due to recent sedimentation rather than resuspension of underlying sediments (Joseph Germano, personal communication, 1987).

The REMOTS images will be used to construct base maps of the entire site, which will include grain size, the depth of potential redox discontinuity, and organism/sediment indices. The aforementioned draft report will compare 1980, 1981, and 1986 data from surveys using contoured maps and will provide volumetric differences in the surveys and determine if sediment transport has occurred. The 1986 survey will be used to establish baseline conditions for further monitoring at the Mud Dump Site. Its results will be used to develop a comprehensive and cost-effective monitoring program for the site and any future ocean disposal sites.

Kill Van Kull/Newark Bay Deepening Project Ocean Disposal Management Plan

The management plan for the Kill Van Kull/Newark Bay Deepening Project (KVK/NB) is an example of how bathymetric and cap stability information is

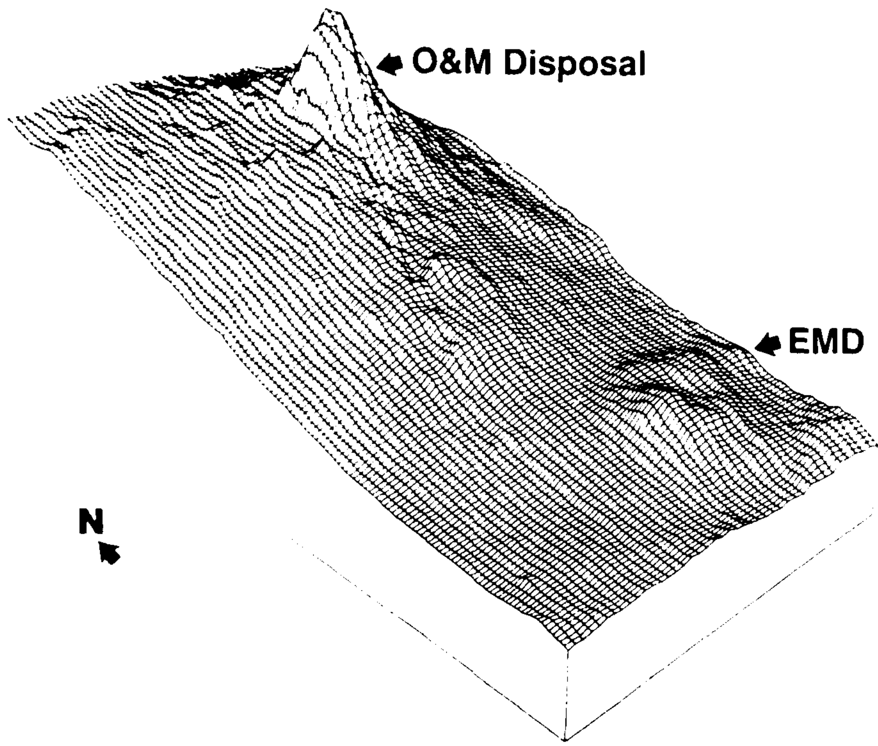


Figure 11. 3-D model of the November 1986 survey

being used by NYD, in cooperation with EPA, to manage dredged material disposal and capping. Based on the 1986 survey discussed previously, NYD and EPA have located and designated two new taut-moored buoys for disposal of dredged material. These will be used for both maintenance material and for new work material from the deepening project, and both are sited adjacent to the existing mound in 62 to 74 feet of water. Siting avoided the restricted quadrant and the EMD (Figure 12).

The KVK/NB management plan addresses technical scenarios for surveying ocean dumping and for capping. The project will require deepening from 35 feet to a 44 foot channel at mlw. The possibility of dioxin contamination has been raised; however, testing indicated no detectable concentrations. EPA has recommended capping of the material regardless of the test results, and NYD will comply with their recommendations. Maintenance material will be used as a cap for the new work material from KVK/NB.

A total of 14.3 MCY of soft sediment and 1.5 MCY of rock will be dredged from this project and associated channels from 1987-1990. Surveys will be conducted before and after KVK dumping. A two-buoy annual rotation management plan will be implemented for disposing and capping of KVK/NB material at the Mud Dump Site.

Disposal restrictions are placed on the northwest and southeast quadrants based on the 1986 surveys. NYD will conduct bathymetric surveys in September 1988 and 1989 to coincide with buoy rotation in the dumping process.

Buoy positioning in the northwest and northeast quadrants will be carried out by NYD. Dredging contractors will dump only at the buoy designated for their project.

Since it has not been proven that rock works well as effective cap material, the rock material from KVK/NB will be placed at the existing center buoy at the Mud Dump Site (Figure 12).

PL 99-662 and Future Capping/Ocean Disposal Management

Section 211 of PL 99-662 requires that a site for dredged material disposal be designated at least 20 miles offshore within 3 years. NYD and EPA have already begun the site selection process. Section 211 also limited the material permitted to go to the present site to sand, rock, and contaminant-free dredged material. A further definition of "acceptable" material has been sought by NYD and EPA. Both NYD and EPA have recommended that only the most contaminated material (requiring capping) be carried to the future 20-mile-offshore site. Other dredged material can continue to be disposed at the present site until capacity is reached. A cost increase of 50 percent in disposal is anticipated.

In order to comply with the 3-year time limit of Section 211, a siting decision will be based on only existing data. Both NYD and EPA are recommending that the time be extended to 4 to 5 years to allow for additional data collection that will allow an intelligent, environmentally sound site selection process. It is likely that future material will be capped 20 miles offshore, and material that currently does not require mitigation will be disposed of at the Mud Dump Site until it reaches capacity.

Summary and Conclusions

The NYD has developed viable management strategies for dredged material disposal requiring mitigation such as capping. These strategies result from continued monitoring and surveys of the Mud Dump Site and from previous dredging studies. These studies indicated that disposal and capping of contaminated dredged material with clean material by point dumping at a taut-moored buoy is an effective technique for ocean disposal of contaminated dredged material in an environmentally sound manner. Heavy metals, organics, and other contaminants are rapidly rendered harmless and are unavailable for potential bioaccumulation.

Capping has been used as an effective management tool in NYD since 1980. Comparison of three different surveys over an 8-year time period indicated that material was accurately placed at the buoy and that it had remained constant.

The MOU between NYD and Region II, EPA, focuses on management and monitoring of the Mud Dump Site. It includes capping and disposal of maintenance and new work material by point dumping, cooperation on testing and permit

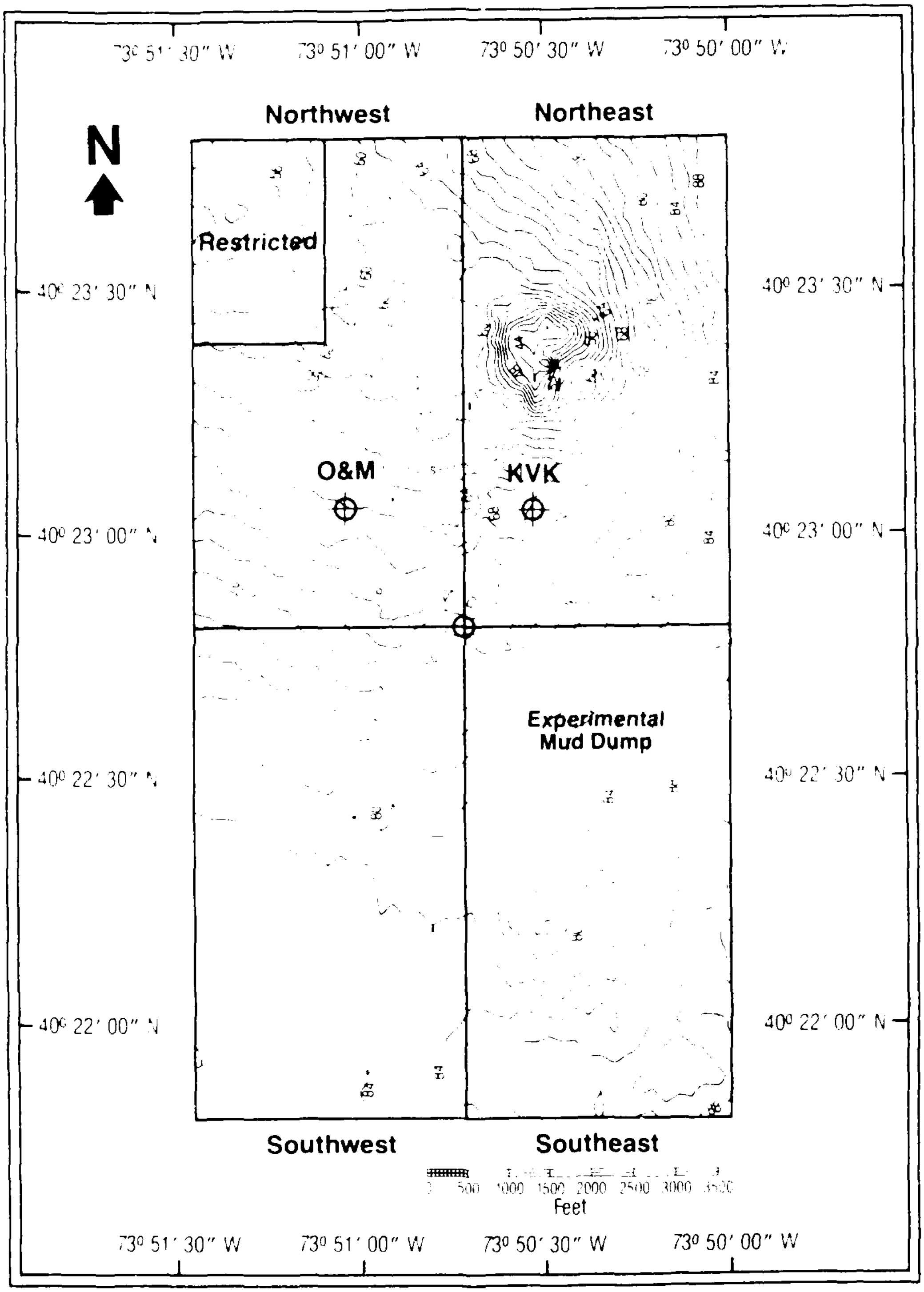


Figure 12. KVK/NB Management Plan

processing, reporting of disposal volumes, alternatives to ocean disposal, and initiation of feasibility studies for designation of a new disposal site 20 miles offshore. Based on the 1986 survey results, EPA and NYD have agreed to a management plan for disposal and capping of material from KVK/NB. Two buoys will be used alternatively during the next 2 years so that maintenance material successively caps the KVK/NB material.

PL 99-662, Section 211, requires that a new ocean disposal site 20 miles offshore be designated within 3 years and that the Mud Dump Site be used only for rock, sand, and "acceptable" material. NYD and EPA are seeking clarification on the definition of "acceptable" material and a time extension to allow data collection. Only material not requiring mitigation such as capping will be placed at the Mud Dump Site once the new site has been designated. Capping has proven to be a beneficial use of dredged material and an effective management tool for disposal of material from NY/NJ Harbor and will continue to be used by NYD on an operational basis in the foreseeable future.

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INNOVATIVE USES OF DREDGED MATERIAL: THE BENEFITS OF SUBAQUEOUS BORROW PITS AS DISPOSAL SITES

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The floor of the Lower Bay of New York Harbor is composed predominantly of sand and gravel that were deposited as the last glaciers receded from this area about 18,000 years ago. It has been estimated that the surficial sand deposits under the Lower Bay alone have a total volume of about 2.6 billion cubic metres. Over the past several decades, sand and gravel have been mined from the flow of the bay for use as construction aggregate and fill. Between 1950 and 1980, more than 42 MCY of sand and gravel has been dredged from the bay. This mining activity has produced a number of subaqueous borrow pits of varying size and depths. The principal ones are shown in Figure 1.

Since 1973, sand mining activity in the Lower Bay has been restricted primarily by environmental concerns, and over the past decade a number of studies have been carried out to address those concerns. For example, Kinsman et al. (1979) and Wong and Wilson (1979) used mathematical models of the waves and tides to examine whether the borrow pits affected beach erosion. Their results indicated that the pits were large enough to noticeably affect the waves and tides. Both the tidal range and the wave energy reaching the shore were slightly increased by the presence of the pits. These changes would tend to aggravate shoreline erosion, although the magnitude of the impact was considered small and difficult to assess.

A second concern arose from the fact that the pits on the West Bank were natural traps for mud. Little or no mud is deposited on the sandy bay floor around the pits, but in them mud was accumulating at rates between 4 and 9-centimetres per year, or about 100 times faster than typical natural rates in other estuaries. The presence of the pits has changed about 1,053 acres of the seafloor from sand to mud. In fact, if mud continues to accumulate in pits as rapidly as it has over the past 10 years, the pits will completely fill in 50 to 100 years. Because of the affinity of many contaminants for fine-grained sediments (e.g., Benniger, Lewis, and Turekian 1975), the pits are also sinks for contaminants in the Lower Bay.

The mud accumulating naturally in the pits on the West Bank has a high organic content, and there was concern that the degradation of this organic matter would deplete the oxygen in the bottom water during the summer. In 1978, measurements showed that the pits on the West Bank did affect the oxygen demand, and lower oxygen concentrations were found there when compared with sandy shallow areas (Swartz and Brinkhuis 1978). Dissolved oxygen concentrations near the bottom low enough to stress animals (<3.5 millilitres per litre) were observed in the pits on several occasions (Swartz and Brinkhuis 1978; NMFS 1984; Conover, Cerrato, and Bokuniewicz 1985).

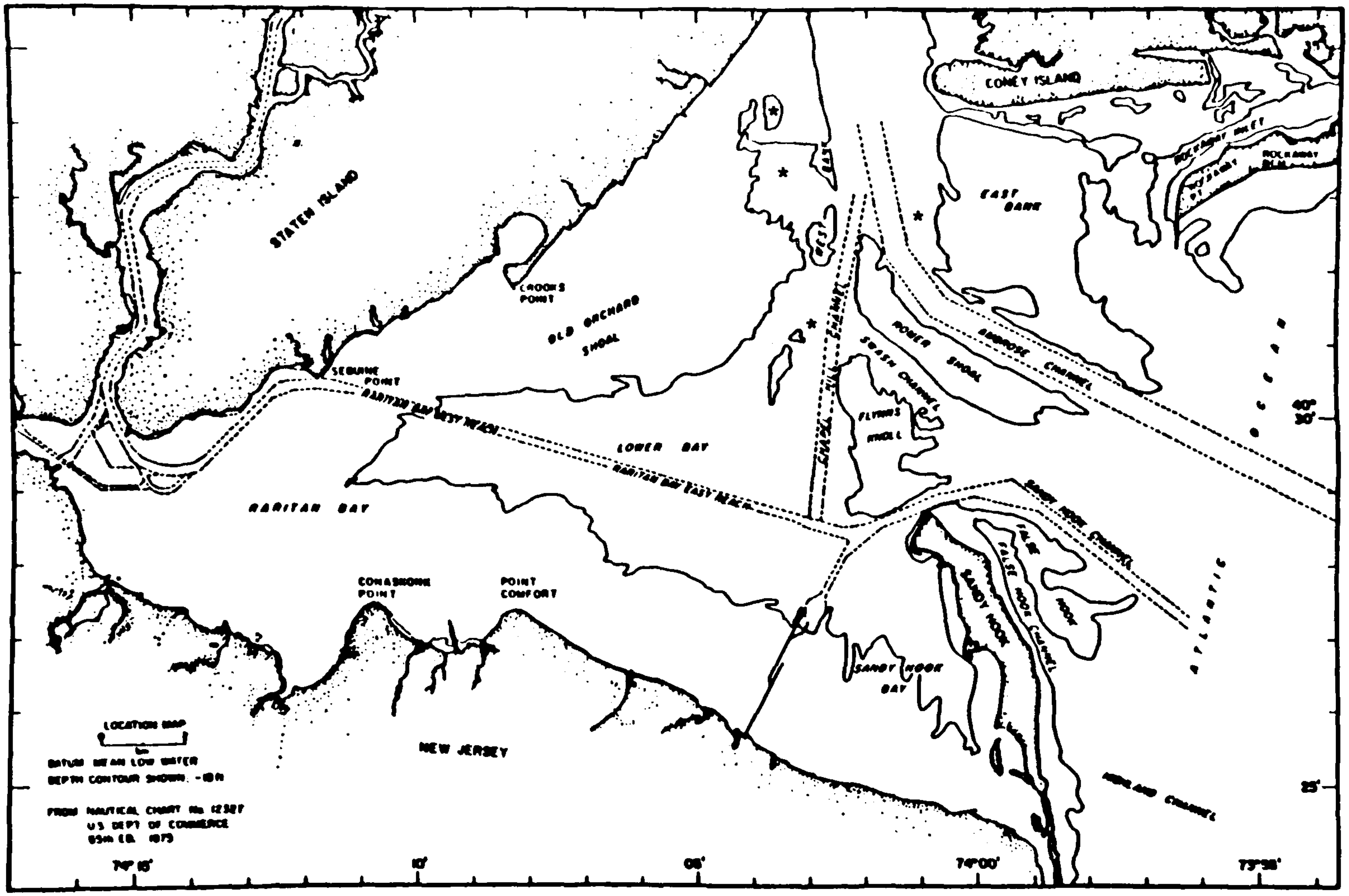

Figure 1. Index map of the Lower Bay. The location of the principal borrow pits are indicated by asterisks

Since the physical environment in the borrow pits differed substantially from the ambient seafloor, an additional concern was their effect on the community structure of the benthos within and adjacent to the pits. To address this concern, a seasonal benthic study was conducted between July 1980 and June 1983 (Cerrato and Scheier 1984). Results indicated that the faunae in borrow pits were distinctly different from the ambient seafloor in terms of species composition and in temporal patterns of abundance, species richness, diversity, and equitability. The faunae within the borrow pits were dominated by opportunistic species and were characterized by very large seasonal changes in abundance and species richness (Figure 2). Extremely low abundances generally occurred during the warmer months, suggesting oxygen stress as a possible cause for the observed pattern. In contrast, the benthic fauna at a control area was more stable and diverse over time. Evidence was also found that the borrow pits affected the structure of the benthos at locations in close proximity to the pits.

Given the documented impacts of existing borrow pits, filling them and reclaiming the sandy seafloor would appear to be a desirable goal. Even the smallest pit, however, has a capacity of over 2 MCY, and the total capacity of pits on the West Bank alone exceeds 25 MCY. The cost of filling these pits would be prohibitive unless a source of free material is available. Dredged material can provide that material, and in addition, burying dredged sediment in subaqueous borrow pits has its own advantages. Much dredged mud is contaminated by agricultural, urban, or industrial products. Whatever the disposal technique used, it is usually mandatory that the material be contained in a disposal site and isolated from the marine environment to the greatest possible extent. Subaqueous pits are attractive containment sites because mud is accumulating in them at very rapid rates and the pit walls are sufficiently steep to limit the spread of dredged sediment during discharge (Bokuniewicz 1979). If the dredged material is deposited in the pit and covered, or capped, then not only could the bay floor be restored to its premined condition, but the dredged mud could also be buried beyond reach of most burrowing animals and beyond the depth of disturbance by storm waves (Bokuniewicz, Cerrato, and Mitchell 1981). Burial keeps the mud in a reduced state so that particle-bound contaminants are unlikely to migrate. Burial at sea also eliminates the problems of ground-water contamination that may be a concern with landfill operations.

The idea that mined pits could be used as containment sites for dredged material is not new. It was suggested at least as early as 1973. However, despite the documented adverse impacts of existing pits, implementation of this disposal alternative in New York Harbor has been proceeding slowly. One reason for caution is that studies have found higher numbers of finfish in borrow pits than in nearby sandy, shallow areas (Pacheco 1983; NMFS 1984; Conover, Cerrato, and Bokuniewicz 1985). Why the borrow pits act to concentrate fish is not completely understood. The dominant fish species found in the area of the borrow pits are primarily migratory species that occur in the Lower Bay for only a short period of time. Many of these dominant species are pelagic feeders and are not utilizing the benthos as a food source. The demersal species, like winter flounder, that are found in the pits do not show a marked preference for the benthic fauna in the pits (Conover, Cerrato, and Bokuniewicz 1985). In addition, there is no evidence that the pits are a spawning or nursery ground. About the only conclusion reached from a

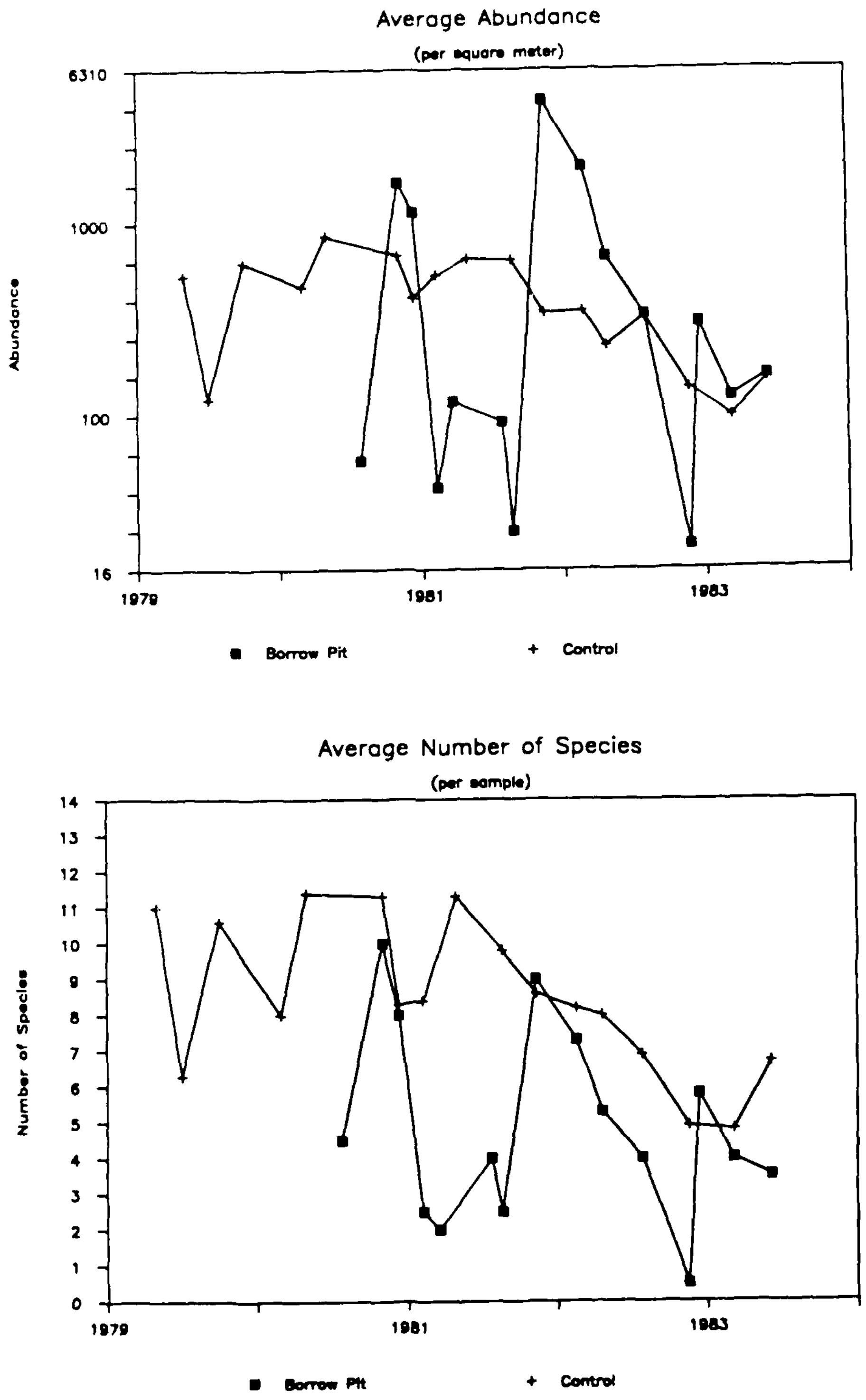

Figure 2. Comparison of benthic abundance and species richness at a borrow pit on the West Bank and a control area approximately 2 kilometres to the southwest

detailed analysis of the available data is that finfish seem to display a general preference for deep, muddy areas (Bokuniewicz, Cerrato, and Hirschberg 1986). A deep, muddy environment is not a unique characteristic of borrow pits in the Lower Bay. Fish were also found to concentrate in ship channels and in naturally deep, muddy areas like Gravesend Bay and Sandy Hook Bay.

There is some concern, therefore, that filling existing borrow pits will affect the recreational fishery in the Lower Bay. It is possible, however, that while the pits concentrate fish and make them easier to catch, they may not increase overall production in the Lower Bay. From a conservation standpoint, preserving existing borrow pits may not be a desirable management strategy for some of the more heavily fished species.

Whether existing pits will be used for the disposal of dredged material has yet to be resolved. Independent of a decision on this matter, the potential also exists to closely couple new sand-mining activity with dredged material disposal. This coupling could revive sand-mining operations in New York Harbor by mitigating some of the adverse impacts of mining.

In conclusion, subaqueous disposal is a viable alternative for isolating and containing dredged sediment. Although no large-scale project of this type has been done, studies in New York Harbor and elsewhere have shown that such an operation is technically feasible and that the concept is environmentally safe. A successful burial operation would require the accurate and deliberate deposition of dredged sediment in a subaqueous pit and burial of the deposit under a sediment cap composed of sand. The basic principles of all the essential features of a successful operation have been demonstrated.

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INNOVATIVE USES OF DREDGED MATERIAL: BENEFITS OF UNDERWATER BERMS

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Mobile, Alabama

I am here today to talk with you about using dredged material to build underwater berms, or as most people refer to them, Murden's Mounds. Using dredged material in this manner has a number of potential benefits to the CE dredging program, our cost-sharing partners, and the environmental resource agencies. Specifically, I will talk about joint efforts coordinated by Bill Murden's Dredging Division at WRSC that involves Mobile District in South Atlantic Division, the research community represented by the Directorate of Research and Development, and the WES. The purpose of these efforts is to demonstrate the feasibility and benefits associated with the berm concept. Before describing these efforts, I would like to give you some background on the berm concept and previous work we have done in this area.

The underwater berm concept, as with any other beneficial use concept, is to use dredged material rather than just dispose of it. For the most part, maintenance and new work dredged material is uncontaminated and is suitable for a wide range of productive uses. Dredged material should therefore be considered a resource. One way we can use this resource is to build underwater features in the shape of berms.

What is a berm? A berm is an underwater mound constructed from dredged material for a specified design. At many navigation projects, large quantities of dredged material are presently being transported many miles to offshore sites. This results in a significant cost factor and makes the material unavailable for beneficial uses. Plans for some of the deepening projects would continue this traditional practice. In contrast, under the berm concept, we would place material in the nearshore zone closer to the navigation project.

Why is the CE interested in underwater berms? Because we want to be forward looking and to examine opportunities to accomplish our mission more cost-effectively, in an environmentally responsible manner, and to practice beneficial use applications of dredged material.

The CE has enormous opportunities within its dredging program to build underwater berms. Presently, the CE dredges about 320 MCY per year, of which 50 MCY is disposed of in the ocean. PL 99-662 authorizes additional dredging of more than 1 billion cubic yards of material. Obviously, the new work dredging will be accomplished in phases over a multiyear period. Dredging by other agencies and industries totals 100 to 150 MCY per year. The US Navy, for example, has an extensive maintenance dredging program and is planning some major new work and deepening projects associated with its Homeporting Program.

There are two approaches to construction of underwater berms. The CE refers to them as feeder and stable approaches. The feeder approach involves relatively shallow water placement where the material could move toward shore. Material would be limited to beach quality sand. The stable approach involves placement in deeper water less subject to waves and currents. Therefore, the material stays in place. A wide range of dredged material types can be used in the construction of stable berms.

The primary benefit of feeder placement is to add sand to the nearshore zone so that it can potentially help reduce erosion of nearby beaches. In many cases, dredging costs can be reduced because nearshore sites are generally closer to the navigation channel.

A stable berm would be a significant, relatively permanent bottom feature that could dissipate storm waves and thus contribute to a reduction in shoreline erosion rates. There could be a zone of reduced wave energy between the completed berm and the shoreline in which additional material could be stockpiled for future beach nourishment. Conventional pipeline dredges could recover this material for direct placement on the beaches. Fishery benefits are also expected as topographic irregularities are created on the ocean floor, enhancing fish habitats. Similar enhancements have been observed at a number of CE ocean disposal sites during recent designation surveys conducted by EPA. As with the feeder approach, dredging cost-savings will occur if haul distances are reduced.

In 1982, the WRSC arranged for the Norfolk District and CERC to conduct a pilot study 4 miles offshore of Virginia Beach, Virginia, in the existing Dam Neck ocean disposal site. The purpose of the pilot study was to determine on a small scale whether mounding could be achieved with maintenance material using conventional equipment. Construction of an underwater feature depends very much on precise control over the exact position of release. Usually disposal areas are very large, and no special effort is made to release the material in any particular place within the overall designated areas. At Dam Neck, approximately 200 MCY had been deposited over a 20-year period, creating only a broad hill with very little relief.

Dredging and disposal at Dam Neck was accomplished by the SUGAR ISLAND and the MANHATTAN ISLAND, two self-propelled, split-hull industry hopper dredges. About 845,000 cubic yards of silt and fine sand was deposited between August and November 1982. The dredging contract required release of the material at a specific point within the Dam Neck site in 34- to 36-foot water depths. The material produced a mound having about 11 feet of relief to the 23-foot contour with 1:130 side slopes and covered an area 1,600 by 2,800 feet.

The Norfolk District pilot study clearly indicates that the hopper dredges and positioning equipment routinely used by industry are capable of constructing a mound. Another important finding was that a significant feature can be created even when the placement material is a mixture of fine sand and silt. Equally important is the fact that the mound has been stable although subjected to ocean storm conditions. Three hurricanes have occurred since creation of the mound in 1982.

The WRSC has briefed the Environmental Advisory Board and the Coastal Engineering Research Board as to the feasibility and potential benefits of berm construction. Both of these technical advisory groups to the Chief of Engineers have endorsed the berm concept in principle. In addition, the NMFS has indicated that the stable berm may contribute to improved fish habitats.

Based on the positive results of the Norfolk District effort and these endorsements, the Director of Civil Works approved a National Demonstration Project to assess and document physical and fishery effects associated with an underwater berm. The national demonstration will be conducted at Mobile Harbor. Why Mobile? The Mobile District has responded innovatively to the environmental challenges brought about by NEPA and the CWA, including the development of improved dredging and disposal equipment and procedures and long-term maintenance plans. In this process, the Mobile District has nurtured a longstanding and productive association with the applied R&D community. Mobile District decided to demonstrate both berm approaches at Mobile Harbor. While the Mobile Harbor location does not offer the large scale cost-savings that appear possible at other locations, the information obtained through this demonstration will have national application.

Before initiating the demonstration, Mobile District coordinated with the local Congressional offices, the local project sponsor, and navigation and environmental interests on numerous occasions as indicated on the slide. The coordination and briefings that occurred resulted in support for the demonstration by all interests.

The demonstration locations are off the coast of Dauphin Island, Alabama. The feeder berm was constructed in February 1987 of sandy dredged material at the outer bar of Sand Island. This island is part of the extensive Mobile tidal delta and has experienced rapid erosion during the last two decades. It presently is an underwater sandbar, with only Pelican Island to the west still emergent. We expect the feeder berm material to move toward Dauphin Island due to predominantly westward longshore currents. This would benefit Dauphin Island, which has also experienced extensive erosion due to recent hurricanes. Approximately 450,000 cubic yards was placed in 18 to 19 feet of water to form a berm about 6 feet in height and 1 mile in length. Two shallow draft industry hopper dredges performed the work. These dredges also have a split-hull design, which was particularly useful for the feeder berm construction in shallow waters.

A stable berm will be constructed approximately 3 miles from Sand Island during Phase I of the deepening project at Mobile Harbor. Work could begin as early as July 1987. The quantity of new material is estimated to be 23.6 MCY. Some maintenance material may also be placed in the berm. Phase I of the project consists of deepening the existing channel from 40 to 45 feet through the Mobile Bay and deepening of the bar channel from 42 to 47 feet, a total distance of 36 miles.

The berm will be located in 40 feet of water at the extreme eastern limits of the EPA-designated disposal area. The completed berm will be approximately 20 feet in height and has side slopes estimated to be about 1:100. It will be about 1 mile wide and 2.5 miles long. This will be the largest underwater feature ever constructed.

To verify the berm concept, it is necessary to conduct appropriate monitoring. This monitoring is a joint effort between Mobile District and CERC. Monitoring of baseline conditions for the feeder berm was initiated in December 1986, and monitoring will continue through December 1987. Baseline data collection for the stable berm will be initiated in May 1987 and will continue through FY 90. Monitoring is being conducted for the entire feeder berm. Only a typical section of the stable berm will be monitored due to its larger size and lengthy construction period.

The same monitoring techniques, in general, will apply to both the feeder and stable berms. In the case of the feeder berm, we expect the material to move downdrift and hopefully contribute to a reduction in shoreline erosion. In the case of the stable berm, the monitoring program will indicate whether it remains in place, contributes to wave energy dissipation, and provides an improved marine habitat.

We are using a variety of monitoring techniques to document behavior of the berms. Fathometer surveys are being used to measure berm elevations, and side scan sonar will be used to help define boundaries of the berms. The surveys of the feeder berm thus far show that the planned configuration was achieved and that the material is beginning to move as anticipated.

Our monitoring programs include collection of surface sediment samples in order to track sediment movement through grain-size analysis. At the stable berm, we will also be taking diver core samples to assess consolidation and spread of the material. We will be measuring the physical forces such as waves and currents that act on the berms. Bottom currents will be tracked using seabed drifters that follow the movement of local currents. We will use several instruments to measure wave climate in the vicinity of the berms, since waves are the principal driving force behind sediment movement in the coastal zone. We will be using both aerial photography and satellite imagery to measure any large-scale movement of the feeder berm caused by storms and to detect turbidity plumes that may develop from either berm.

Finally, we will be evaluating the effects of the stable berm on fisheries by conducting diver censuses of migratory species. Trawling will be conducted to inventory forage species.

In summary, as with any beneficial use concept, dredged material for berm construction should be considered a resource rather than a waste product. The National Demonstration Project has been fully coordinated with all interested parties. The potential benefits include decreased dredging costs, decreased shoreline erosion, and an enhanced fisheries. In addition, the results from the project at Mobile Harbor can be applied to other navigation projects across the nation.

INNOVATIVE USES OF DREDGED MATERIAL: SOIL STABILIZATION USING DREDGED MATERIAL

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Annapolis, Maryland

Introduction

We are all aware of the ever-predominant problem of dredging disposal and the ever-increasing challenge of finding some beneficial uses for that material. For example, considerable work has been done to create wildlife habitats, with some very noteworthy results. Unfortunately, circumstances have to be quite favorable to achieve such uses, and this is not usually the case. Conventional methods such as wicking, ditching, wellpoints, sand blankets, and their combinations, may also not be the answer to disposal problems. The answer may lie in a new process called TRIFIRMEX, Trident Engineering's unique solution for some of the many and varied problems of dredged material and sludge disposal.

Our interest in soil and dredged material stabilization dates from 1968 when Hart-Miller Island was in initial planning stages. The State of Maryland asked Trident to investigate methods to stabilize the material planned for deposition in Hart-Miller in 1971, and the company has conducted stabilization studies and research since that time. Our work expanded to include hazardous and toxic wastes, particularly industrial wastes, and we helped develop the environmental criteria for the Maryland Environmental Service. Trident holds two patents on processes that will stabilize dredged material and wastes.

The Stabilization Process

Trident's basic process utilizes a little-known characteristic of an inexpensive, semi-waste material that is treated and refined to become the stabilizing agent in a powdered product called Firmex. Firmex stabilizes most dredged material on a time-controlled basis. In most test cases, usable new land has been produced within 1 month out of soupy silt and clay dredged material. The process does not work on coarse-grained materials.

Two factors dictate the amount or percentage of Firmex required: (a) the time for hardening or attaining full load-bearing capability and (b) the load-bearing capacity to be attained. Usually, 8 to 15 percent of Firmex to the dry solids content has been the amount of Firmex needed for stabilization. A small amount of the substance will begin the firming action, and increasing the amount tends to decrease the time required for the process to be complete. It is capable of developing load-bearing values from 0.5 ton per square feet with 22-percent solids, to over 4.5 tons per square foot with 33-percent solids, in a time frame of approximately 1 month.

Dredged material containing heavy metals, oils, tars, chemical residues, and other contaminants is almost impermeable and can reduce the in situ leachate to a permissable level. Our process develops a permeability coefficient averaging 1 by 10^{-6} centimetres per second. Trident is interested in modifying and adapting Firmex to stabilize hazardous materials and lock in offensive leachates. Early tests using muck from the Chesapeake Bay held in the SEAGIRT containment area have indicated that we are on the right track. Results showed the above value for permeability, and 2.5 tons per square foot load-bearing capacity within 40 days. Leachate tests on mature samples showed rates of 0.1 part per million using the EPA specified testing methods. Not only did the mixture become hardened and impermeable, but the leachate was essentially reduced to zero. Allied Chemical Company, a major mining and chemical company, will be using Firmex to treat and stabilize a specific type of toxic mine waste.

SCM Glidden, another large US corporation, produces 1.2 MCY yearly of a waste that, while nonhazardous, becomes liquid when agitated. Their handling and transportation costs are excessive, and the material must be mixed with a solid to handle. Firmex can be used to stabilize this material for easier handling and disposal. Industrial sludge from sources such as boiler wash-down, condenser and duct cleaning, water treatment systems is loaded with metals and chemicals. Firmex stabilizes this material and changes the sludge from a spongy, semidry, pulplike mass to a hard and dry material in a matter of weeks.

Trident is concentrating its stabilization efforts on the creation of immediately usable landfill. We are currently working on stabilization problems associated with Hart-Miller and SEAGIRT. We must find the most efficient and economical way to remove large quantities of material, treat and replace at a cost that is competitive with the most accepted dewatering and capping practices. A key factor in calculating cost-efficiency must be the rapid time in which land becomes available for use after it has been used as a disposal site. Revenues generated between stabilization using Firmex and the time conventional dewatering methods would have taken to reach the same degree of stabilization should be considered.

Toward this end, Trident advocates using the IN [illegible] FIRMEX process, which consists of mixing the powder Firmex into a semifluid mud, controlling the pH, placing the material into a permanent depository site, and allowing it to harden in place. It can be compared mechanically with the mixing of concrete. For some mucks/muds, additional additives are needed. An average mix would require about 10-percent additive of total solids weight to produce a load-bearing value of [illegible] tons per square foot in [illegible] to [illegible] days. The water content of the muck/mud is hydrated and encapsulated, locked-in just as it is in concrete. One ton of material mixed with Firmex would produce slightly more than one ton of stabilized landfill.

An example would be as follows. A cubic yard of average Chesapeake Bay dredged material containing 30-percent solids weighs more than 1 ton. If we took 1 ton per cubic yard, 30-percent solids by weight would give us 600 pounds of solids. An addition of 10-percent Firmex would require 60 pounds of the powder at $56 per ton, or $1.68 per 60 pounds. Therefore, a 10-percent mix to stabilize 1 cubic yard of dredged material from Chesapeake

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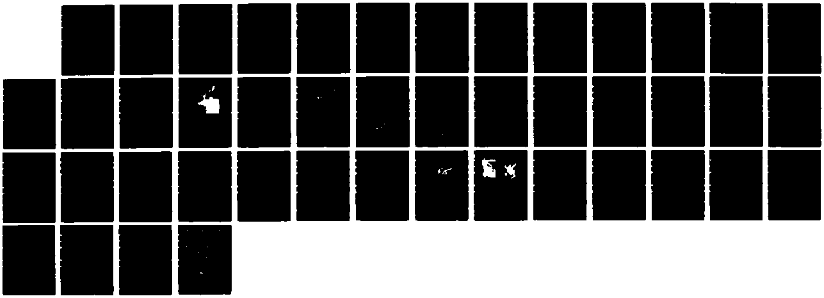

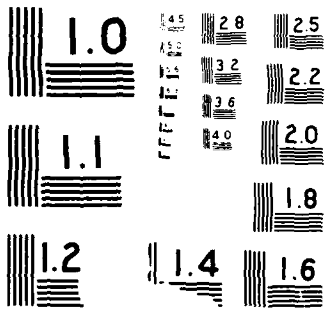
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Bay would cost an additional \$1.68 per cubic yard. Depending upon type of material, costs may be as high as \$3 per cubic yard, and this does not include labor, handling, or mixing costs.

We know we can stabilize many types of material from laboratory tests. We are ready for field tests in large quantities using the TRIFIRMEX process.

Procedures and Recommendations

In a sequence of steps to further test and use Firmex, we recommend:

a. Laboratory tests of each specific substance to determine if it can be stabilized and how much material it will take to do so. We are presently doing this at no cost to our customers.

b. Develop the economic answers, which means the most effective, efficient, and economic mixes to meet each time and load-bearing requirement. We make an assumption here that there are no leachate problems. If there are leachate problems, tighter requirements will be needed.

c. Develop the engineering answers for materials handling, machinery, and labor.

d. Develop the conceptual design of an optimum installation to suit individual requirements, including level of manpower, staffing, rate of production, and cost per cubic yard.

Use of Firmex has several major advantages. One is costs. The TRIFIRMEX process is usually less expensive than pozzolanic systems. Time control definitely favors our process because we can predict when a site is ready for development and use as a landfill. We can also accelerate or slow down the firming process if necessary to adjust final costs if necessary.

Our ability to vary the physical properties of dredged material or sludge is important for beneficial uses. The most obvious beneficial uses include:

a. Land reclamation for parking, building, or recreational sites in shorter time periods than presently possible using previously unstable material.

b. Road beds, either used alone or mixed with other materials, and capped with asphalt, concrete, and other road-capping material.

c. Lining or encasement material in confined disposal sites to prevent leaching of undesirable elements.

d. Use for building levees or retention structures.

e. Cape material to cover filled disposal sites.

f. Building material such as building blocks similar to adobe bricks.

g. Erosion control material in selected applications, such as in situ breakwaters.

Additional data are needed, and there are no cost figures available for any of the above mentioned beneficial uses. We would be happy to consider other uses and suggestions from anyone here. We have conducted thousands of tests, and the uniformity of our findings has given us the assurance that this is truly a viable technology in treating and tailoring dredged material. The method selected for mixing and handling of the material determines the final cost of each site-specific stabilization.

Summary

To summarize, TRIFIRMEX is a relatively inexpensive process that can stabilize very soft, unstable, wet soils such as dredged material, sludge, and mine wastes. Using Firmex as the stabilizing agent, this process:

a. Effectively stabilizes soils containing high amounts of water (up to 75 percent) and organic materials in a short period of time.

b. Develops material with load-bearing capabilities of 1,000 to 10,000 pounds per square foot in less than 60 days.

c. Reduces the plasticity index of the stabilized soil as its load-bearing properties are increased.

d. Stabilizes material to develop a low permeability coefficient.

e. Locks in offensive leachates.

f. Reduces the leaching of heavy metals and other hazardous materials to a generally acceptable level.

g. Results in no measurable exothermic reaction.

h. Produces freshly treated material that can be pumped, trucked, or barged to its final disposal site prior to its stabilization.

i. Hydrates, or locks-in, the water which can be fresh, brackish, or salt.

j. Uses Firmex as an additive, which is a neutral and nontoxic form of silica specially processed to give it a unique hardening capability when wetted.

Other advantages of the TRIFIRMEX process include improvement of the working environment around major construction sites, elimination of the cost of removing soft material and replacing it with firm material for construction purposes, improvement of the geotechnical characteristics of unsuitable material, and the fact that there is no excess water to remove from the site.

QUESTION: Are dissolved oxygen concentrations significant enough to use in determining whether a borrow pit should be used as a disposal site?

DR. CERRATO: Just dissolved oxygen? No, not alone. The problem we've had in the past with dissolved oxygen is in accurately measuring it. Our occasional measurements showed it at levels within pits below that of surrounding areas but just how low it gets during the year, we don't know. You may also have low dissolved oxygen levels just a few centimetres off the bottom, and you can't really measure that.

QUESTION: How about resuspension of bottom sediments in the borrow pits?

DR. CERRATO: They're not really being resuspended. It is an area that accumulates sediment.

QUESTION: Are they being transported at all?

DR. CERRATO: Probably not. There is natural accumulation of fine-grained material transported down the Hudson River, and it is accumulating in the borrow pits. The surrounding seafloor is sandy.

QUESTION: Once you dump in the holes, is there a resuspension of the dredged material?

DR. CERRATO: There would probably be some resuspension during discharge, but with the steep walls of the pits, it would be less than the usual disposal dredging operation.

QUESTION: What is the size of your sanitary landfill project in acres? What is the capacity in cubic yards? How often did you have a turnover of the material?

MR. WAFFENSCHMIDT: First of all, this was an experimental pilot project and not a large-scale project. Each dewatering basin is 0.25 acre in size, relatively small areas. At this point, we don't know how much material we can handle and dewater at once. I am projecting that we would like to have the capability to process 300,000 cubic yards per year, once this project is in full operation. This would yield 150,000 cubic yards of cover material and remove 5,000 trucks each year from New York City roads, primarily Staten Island. Whether those volumes are achievable with our present space and operation, I don't know yet. The biggest problem in working with the dredged material is the dewatering process, and this is making us have to use thinner lifts, so we may have to modify our goals. We disposed of approximately 400,000 cubic yards of dredged material last year.

QUESTION: Have you given any thought to incineration of contaminated material to reduce toxicity of the material you use?

MR. WAFFENSCHMIDT: Our material is not contaminated in general. Our dredged material does not generally require capping for ocean disposal.

QUESTION: What kind of percent solids did you find?

MR. WAFFENSCHMIDT: Since we are using mechanical dredging, we have a higher percent solids than hydraulic dredging. Grain size of dredged material is going to determine percent solids and dewatering ability. Our goal is to create fill material that is operationally acceptable for equipment to work.

AUDIENCE COMMENT: As a general rule, dredged material is 40- to 50-percent solids (mechanical dredging).

QUESTION: Would you discuss the currents in the area of the Mud Dump Site, and what effect they may have on capping. Further, was there a lack of integrity to the cap, and what means would be available to address the problem?

MS. COCH: In our sediment transport studies, the area was found to be relatively stable both with and without the cap. The cap is intact and seems to be remaining so, even with hurricanes and winter storms. We are trying to be sure that the cap remains stable.

QUESTION: Do you anticipate a long-term monitoring program with that? What is going to happen 50 years from now?

MS. COCH: Even without the MOA, we had a long-term monitoring plan for the entire Mud Dump Site. Our initial surveys are serving as baseline data for the site.

QUESTION: For a small capacity site, how much would it cost to use Firmex, and what technology would be required?

MR. MARQUAND: You mean in a small mechanical dredging operation? Clamshell dredged have 40- to 50-percent solids, and hopper and cutterhead dredges are 10- to 15-percent solids. Our process will not work very well unless you have at least 25+ percent solids. Dewatering of hydraulically dredged material will achieve this percentage of solids. Fly ash will do the same thing. For tests, we put the dredged material into a cement mixer, throw in the Firmex, and then mix and dump. This is very expensive and can be used only for tests. One method we recommend is using a pump attached to the disposal pipe that feeds the additives into the slurry. Each case is different, depending upon the end use of the site. Handling costs are $10 or less per yard, and with $2 for additives per yard, total costs are about $12 per cubic yard.

COMMENT (MR. BIGFORD): A lot of the examples I have heard today suggest that dredged material use may be better than what was there in the first place. The idea of capping is something we've worked with the CE on, but whether it's successful depends on depth of the water and cap, movement of the water, and the animals that may use the site. Berms are not all beneficial, depending upon where they are placed. Borrow pits may become established habitats, and they can no longer be used for disposal, just like islands that have been created for bird habitat.

COMMENT: One big difference is that bird island benefits from additions of dredged material.

MS. COCH: Our Interagency Steering Committee evaluates each of these alternatives, and we don't view them as panaceas.

DR. LANDIN: I'd like to respond to Tom Bigford's comment with regard to island built for waterbirds and other wildlife. One of the management techniques we recommend for use by the CE for colonial waterbirds is continued, periodic disposal on these islands to set back vegetation successional stages. This allows seabirds and shorebirds requiring bare ground habitat to continue to use the islands for nesting. It's a different situation in many ways from subaqueous borrow pits.

MR. LANGAN: We rely heavily on long-term monitoring to determine the success of our berms. Monitoring these berms is expensive, but we feel it's the best and only way to know what we have. We are looking at the sites more for shore protection, but we also consider that they have potential for marine habitat and are monitoring for that as well.

QUESTION: You mentioned using selected depths of dredged material in borrow pits and monitoring these?

DR. CERRATO: Yes, we have discussed doing this. One of the disposal options open to the Interagency Steering Committee is to partially fill a pit.

QUESTION: Do you know if there is a critical depth?

DR. CERRATO: No, I don't know that, but it would possibly be based on a combination of site-specific factors and the characteristics of the dredged material.

LONG-TERM DISPOSAL SITE PROBLEMS AND CONFLICTS: OPENING REMARKS

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I know it's been a long day, but bear with us, because we have four very good speakers. I'm going to change the pace here and let you ask one or two questions of each speaker after their talks, and then ask other questions at the end of our session.

I've listened through the 2 days of talks in the workshop, and we've apparently done a lot of good stuff with dredged material! But, a lot of these projects have been on the short-term, project-by-project. We need to get away from thinking short-term and start planning and implementing long-term strategies for dredging. That's basically what we are going to talk about in this session.

Our first speaker is Dr. Bill Klesch, formerly of Baltimore District and now at the Office, Chief of Engineers (OCE) as an environmental planner. Bill has worked for the CE for the past 13 years. He's here to talk about the CE's LTMS initiative.

Our second speaker is John Tavolaro of New York District, who chaired the previous session. John is Chief of the Water Quality Compliance Branch. He's going to address a problem all CE Districts have faced--that just because a long-term alternative is engineeringly feasible and environmentally sound, there is no guarantee that it will be the alternative chosen, for many reasons that often have no valid basis and that are out of the CE's decision-making process.

Dr. Glenn Kinser, Chief of the Annapolis Field Office of the FWS is our third speaker. Glenn has worked for the FWS for the past 13 years and is going to talk to us about alternatives for the future.

Our final speaker of this session is Dave Nelson from the Coastal Ecology Group at WES. Dave has worked for the CE for a number of years in Rock Island District and at WES and prior to that worked for FWS. He is going to present us with an intriging, low-level monitoring technique called the BRAT that can determine long-term fisheries resources over any bay or lake bottom, including dredged material.

LONG-TERM DISPOSAL SITE PROBLEMS AND CONFLICTS: LONG-TERM MANAGEMENT STRATEGY (LTMS) FOR THE DISPOSAL OF DREDGED MATERIAL: CORPS-WIDE IMPLEMENTATION

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Introduction

The timely, technically feasible, cost-effective and environmentally acceptable disposal of dredged material continues to be the largest and most difficult management problem associated with the national navigation program of the CE. The CE annually dredges about 320 MCY from over 25,000 miles of navigation channels, ports, and associated channels within the United States. With the newly authorized navigation improvements for major coastal ports contained within the WRDA (PL 99-662), this maintenance figure could easily be increased. Therefore, it can be expected that the magnitude of the existing problem of disposal will increase significantly. In order to arrive at the best possible solution, a concentrated effort must be devoted to this problem.

Associated with the efficient management of our navigation program is the need to provide adequate disposal facilities for both the periodic maintenance dredging required at the various existing projects and for the improvement of those various projects as authorized in PL 99-662. A number of prominent scientific and engineering groups, e.g., the Chief of Engineer's Environmental Advisory Board, the President's National Advisory Committee on Oceans and Atmosphere, the National Academy of Engineering's Marine Board, the CE's Coastal Engineering Research Board, and most recently, the Congressional Office of Technology Assessment, have all strongly endorsed the development of an LTMS as the most effective manner in which to manage the CE navigation program.

Additionally, a number of State organizations and EPA are now pursuing ambitious programs to implement the LTMS concept for large estuarine systems, e.g. Puget Sound and the Chesapeake Bay. Further, recent amendments to Title II of the Ocean Dumping Act (PL 99-272) direct EPA, in cooperation with the CE and other appropriate agencies, to develop long-range plans for the disposal of materials within coastal waters.

National Workshop Recommendations

In recognition of the disposal site problem outlined above, a national workshop was held in Jackson, Mississippi, in August 1985 to review the experience of CE Divisions and Districts with the LTMS concept. In addition, their views were sought on the future direction of a CE-wide LTMS initiative. Nearly 100 CE professionals attended, representing OCE, WRSC, 21 Districts, 8 Divisions, and 2 laboratories. After 2.5 days of deliberations, the

workshop attendees concluded that the LTMS concept was viable and should be implemented. In an effort to aid in LTMS implementation, 35 recommendations were developed around 6 general topic areas. These topic areas were: (a) feasibility planning for LTMS, (b) dredging and engineering needs, (c) sediment characterization, (d) significant resource characterization, (e) navigation needs, and (f) legislative compliance and management options. A summary of the recommendations of the working groups follows, each representing a topic area. When a similar recommendation was developed by several working groups, that recommendation will only be summarized for the first working group in which it appeared.

Working Group I: Feasibility Planning for LTMS

a. The CE is a recognized leader in dredging and dredging technology; thus, it would be in our best interest to assume a leadership role and to develop and implement LTMSs for the disposal of dredged material.

b. The concept of the LTMS is viable and should be pursued at the District level subject to the following conditions. LTMSs should be actively encouraged and supported by higher authority. The authority to undertake LTMSs should be clarified. LTMSs should be flexible enough to accommodate legislative change. Short-term operations problems should be addressed first, and all LTMSs should be natural resource based.

c. The CE planning process and experience in its implementation should be relied upon in developing any LTMS. However, there are specific aspects that should be addressed, including the concept of beneficial uses, the critical examination of traditional navigation design practices, the examination of system-wide navigation programs as well as individual projects; the incorporation of risk assessment techniques, and the institutionalization of procedures for the evaluation of planning techniques (postconstruction).

d. Coordination, both internal CE and interagency, should be considered the critical element, with every effort being given to develop as complete a program as possible including comprehensive public involvement activities.

Working Group II: Dredging and Engineering Needs

a. Regarding channel design, their configuration should reflect capabilities of available dredges, and consideration of authorized channel locations and depths should be more flexible to allow for cost-savings.

b. There is a need to improve our ability to predict shoaling and scouring, both as to location and volumes (in particular fine-grained materials), in open-water sites, and to provide better geotechnical guidance for the characterization of new work material.

c. We need to manage disposal sites for the long-term, considering the future use of the site, and should continue to maintain a leadership role in their design for both contaminated and noncontaminated material.

d. Districts should make conscious efforts to coordinate construction schedules, thereby staging construction, lessening the competition for dredges, and reducing equipment shortages within the same dredging region.

e. More emphasis should be placed upon dredging and dredging management as a professional discipline via the encouragement of cross-training of military and civilian personnel in the form of multidisciplinary teams.

f. There is a need to examine our contracting procedures to encourage innovation and/or recognize these innovations currently in place that allow work to be conducted in a timely, economical, and environmentally sensitive manner by fostering inter-District communication, e.g., exchange of cost information and the blending of dredging experience with cost- estimating procedures.

g. Environmental information should continue to play a major role in the selection of disposal areas. However, a more effective mechanism should be developed to transfer R&D results to the field and to the attention of the resource agencies with which we coordinate.

h. We need to improve the mechanisms (workshops, briefings, videos, and other media) whereby information is distributed among the professions involved in dredging and its evaluation both within and outside the CE.

Working Group III: Sediment Characterization

a. We need to have a comprehensive listing of the requirements of the various environmental laws that affect navigation projects, specifically, a definition of information sufficiency as it relates to the adequacy of environmental documentation.

b. The CE must retain financial responsibility for testing and sediment characterization in general and seek to identify ways to reduce costs while assuring environmental protection, including streamlined procurement procedures and laboratory certification.

c. Contaminated sediment evaluation should use a tiered approach considering whether or not there is a reason to believe the sediments are contaminated (historic records). Contaminant evaluation should be "effects" based using similar species. The analytical sensitivity should be based upon the effects concentrations using the same species.

d. We need to improve the procedures for sediment characterization, including recognition of data variability, guidance on hazard and risk assessment, the hydrodynamic conditions at the dredging and disposal site, and the formulation of clear monitoring objectives.

e. Seek to improve the transfer of sediment characterization data among Districts and laboratories via computer information retrieval systems.

f. Increase the use of Section 115 (In-Place Toxic Pollutants) of the Clean Water Act (as amended) for appropriately categorized sediments.

Working Session IV: Significant Resource Characterization

a. Recognizing that the development of an LTMS will be a multiagency task, the CE should promote greater input and cooperation from project sponsors, resource agencies, and other appropriate groups.

b. Any LTMS must be reviewed periodically to allow for administrative and legislative changes in the region and for the problems and needs of the respective projects within the region.

c. Beneficial uses and resource management of dredged material should be incorporated into all LTMSs to gain wider acceptance of the LTMS and to make disposal operations more cost-efficient.

d. Those policies, regulations, etc., relative to natural resources need to be completely reviewed prior to the development of any LTMS and reaffirmed or modified as appropriate, periodically.

e. Promote the timely technology transfer of LTMS resource information among the Districts, Divisions, Headquarters, laboratories, and the appropriate resource agencies with which we coordinate.

f. LTMS for the disposal of dredged material should be established as an agency goal, with appropriate, regional LTMSs developed by the Districts consistent with agency funding and authorization guidance.

Working Group V: Navigation Needs

a. There is an abundance of management tools and approaches being used in the field. However, the general concept of an LTMS should be recognized and encouraged at the Headquarters level and any field initiatives in this area given due credit and considered in the development of any national guidance.

b. Recognition must be given to new cost-sharing proposals contained in P. L. 99-662 and how they will affect the development of any LTMS.

c. There should be encouragement of innovative practices and procedures or the innovative use of long-established practices, e.g. advanced maintenance dredging, use of newly developed or applied technology to dredging and disposal problems, and strategic relocation of disposal areas. The critical evaluation of navigation design practices, the incorporation of engineering solutions to limit the amount of sediment reaching navigation channels, and

the consideration of regulatory strategies to lessen and/or eliminate adverse impacts associated with private sector dredging activities must be considered.

d. Regarding the projection of navigation needs and benefits, it was felt that flexibility needs to be incorporated into the process through the periodic assessment of original forecasts. This could be improved by increased communication among Districts and the establishment of an improved data collection and management system.

Working Group VI: Legislative Compliance and Management Options

a. The CE policy on mitigation needs to be reconsidered, whereby the concept is fully incorporated into the planning process rather than relegating it to the end. (The CE mitigation policy has been changed in a manner similar to this recommendation with the passage of P. L. 99-662, Section 906).

b. The planning process envisioned by an LTMS should consider the benefits generated by the productive use of dredged material and appropriate consideration made with respect to lessening the degree of mitigation required. Along these same lines, a national workshop on beneficial/productive uses should be conducted. (This workshop was held in Pensacola, Florida, in October 1986).

c. Environmental documents need to be flexible enough to incorporate environmentally compatible operational changes without reopening the administrative (NEPA) record.

d. The coordination envisioned with the development of an LTMS should consider processes to facilitate the long-term certification of water quality, coastal zone requirements, and other State and/or local authority requirements.

e. The management options considered by any LTMS should be comprehensive enough to include disposal activities equally within all media, e.g., aquatic, wetlands, and terrestrial. Full consideration of the "no action" alternative should be embraced along with the concept of "beneficial uses" of dredged material.

f. Each alternative will be a collection of management options developed at the same level of detail to facilitate comparison among alternatives leading to a recommended solution via the CE planning process.

Recommendations Summary

A comparison of an initial appraisal of the need for the LTMS concept conducted by Headquarters and the final recommendations of the workshop participants indicated they were in close agreement. Of the 35 final recommendations developed at the workshop, there were four areas that were either constantly referenced or repeatedly emphasized in the recommendations. These

four areas were (a) the consideration of beneficial uses of dredged material, (b) the need for a comprehensive coordination and public involvement program, (c) the use of the CE planning expertise and process, and (d) the need to consider the implications of new cost-sharing provisions being discussed within the Congress at the time of the workshop.

Activities Subsequent to the National Workshop

Following the national workshop, a working group was convened in May 1986 to define the procedure(s) necessary to implement the LTMS concept and to determine any benefits and constraints likely to be encountered. This working group was composed of facilitators and field personnel that had attended the national workshop and thus had first hand knowledge of the discussions and the recommendations. This working group produced a paper entitled "Long-Term Management Strategies for the CE Navigation Program--Policy and Management Issues." The paper outlined policy considerations such as referencing the CE proposed dredging regulation which speaks to the development of LTMS and the use of innovating methods to streamline the regulatory process. The paper suggests criteria that should be incorporated into guidance to Divisions and Districts when developing an LTMS and suggested program objectives. Identified criteria include the reduction of costs, the reduction of dredging workload requirements, the incorporation of beneficial uses for dredged material, and the maximization of management techniques to improve efficiency. The paper outlines a framework to be utilized in the development of any LTMS, from the development and selection of a viable plan to the periodic update of that plan to account for changing public and legislative conditions. Finally, 13 benefit categories expected to be derived from the implementation of an LTMS were defined as follows:

a. Avoidance of conflict and the promotion of a cooperative atmosphere among the CE and natural resource agencies as active partners in the development of any LTMS.

b. Allowance for the timely completion of dredging activities due to the elimination or reduction of environmental conflicts, as they will have been considered in the development of any LTMS and should be identified prior to the initiation of any operational activity. Significant cost-savings, tangible and intangible, will be realized.

c. Avoidance and/or lessening of potential litigation for environmental reasons thereby reducing delays and associated costs.

d. Promoting the increased perception of the CE as an environmentally responsible agency.

e. Promoting of advanced programming of District (O&M) dredging and disposal activities leading to more efficient utilization of District resources (people and funding) and the provision of greater flexibility in programming due to the increased lead times provided with the implementation of an LTMS.

f. Elimination of delays due to conflicts in the identification of suitable disposal areas due to the advance identification of sites as part of the LTMS.

g. Promotion and encouragement of the perception of the CE as an innovative leader in the area of dredging and dredging technology.

h. Encouragement of the incorporation of R&D products into active operational and planning programs.

i. Through the advanced assessment of disposal alternatives, resources and/or engineering problems should be identified early enough to be addressed, as necessary, through a R&D program, thereby reducing the time between problem identification and field application.

j. Promotion of an intensive coordination effort, both among CE elements (planning, operations, regulatory, etc.) and State and other Federal resource agencies, enhancing the efficiency of operations and leading to a better understanding of each other's program goals and objectives.

k. Through the active participation of State and Federal natural resource agencies in the development of any LTMS, the issuance of any required permits/certification should be expedited, further reducing project delays.

l. Incorporation of a tiered evaluation, testing, and assessment protocol, providing a rational, scientific approach to disposal problems associated with highly contaminated dredged materials that should minimize operational delays leading to significant time and cost-savings.

m. Incorporation of the concept of beneficial uses such that enough lead time could be provided to convince resource agencies of the concept's usefulness and legitimacy, thereby reducing project construction delays and costs when considering beneficial uses. Further, the concept of beneficial uses may also be used to simultaneously address State and local natural resource objectives.

Although there are expected to be numerous benefits associated with the implementation of an LTMS, the concept is not without its drawbacks that should be considered before such an effort is undertaken and institutionalized. These potential constraints are as follows:

a. The development of an LTMS is expected to be time-consuming and initially expensive particularly in these times of reduced Federal budgets and staffs.

b. The plans developed are not legally binding and are subject to shifting agency policy and changes in the acceptability of current dredging and disposal practices.

c. The development of any LTMS must be in compliance with local and State statutory requirements which themselves are subject to change.

d. The question of the CE authority to undertake the concept of developing LTMSs needs to be examined critically as there is the perception, either real or otherwise, that we cannot undertake such an activity.

e. The impact of the newly initiated project and study cost-sharing proposals of PL 99-662 needs to be critically examined in reference to the proposed LTMS concept.

f. The needs and responsibilities of local interests will need to be balanced against those of the Federal government regarding navigation improvements and O&M.

g. The political environment will need to be considered from the standpoint that it may have an effect upon the agreements reached in developing an LTMS. However, it is nearly impossible to predict the nature of these effects.

Status

The proceedings of the LTMS Workshop were edited, reviewed, and have now been published and distributed to CE Divisions and Districts with a cover letter dated 23 December 1986 from the Director of Civil Works, MG Hatch, endorsing the LTMS concept and informing field offices of the next steps to be taken in the concept's implementation. MG Hatch has established an LTMS Steering Committee composed of representatives of the Operations and Readiness, Policy, and Planning Divisions from within the Directorate of Civil Works, the Dredging Division of WRSC, and the WES. The Steering Committee has been directed to finalize the conceptual LTMS framework and accompanying policy guidance developed by the LTMS working group, to select a model District(s) for LTMS demonstration and preparation of a "lessons learned" document, to document the benefits from the implementation of LTMS, and to develop the appropriate LTMS information/technology transfer procedures (how-to workshops, training and/or short courses, multimedia presentations, and/or publications for use by our field offices). To date the Steering Committee has endorsed the conceptual LTMS framework and is in the process of selecting a model District(s) to demonstrate the LTMS concept and prepare a report on its implementation.

Questions regarding the LTMS concept and the actions of the steering committee should be directed to either Dr. William L. Klesch (DAEN-CWP-W; FTS 272-1979) or Mr. David B. Mathis (WRSC-D; FTS 385-3099). Additional copies of the proceedings of the national workshop are available upon request from the WES.

LONG-TERM DISPOSAL SITE PROBLEMS AND CONFLICTS:
DREDGED MATERIAL DISPOSAL MANAGEMENT PLAN FOR THE PORT OF NEW YORK AND NEW JERSEY: TECHNICAL FEASIBILITY VERSUS ACCEPTABILITY

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Introduction

The Dredged Material Disposal Management Plan for the Port of New York and New Jersey began in 1980 and is scheduled for completion by the end of 1987. Its purpose is to systematically study the feasibility of regional dredged material disposal alternatives for the Port, which had never been done in the past. Ocean disposal had historically been the disposal method of choice for this area. However, with the enactment of the Ocean Dumping Act, which states that practicable alternatives to ocean dumping must be explored before ocean dumping be allowed, it became evident that a feasibility study such as this was necessary.

The alternatives studied included capping at the ocean dumping site and in subaqueous borrow pits, construction of large containment islands and of smaller areas or wetlands stabilization areas adjacent to the shore, confined upland disposal, use of dredged material as sanitary landfill cover, and beach nourishment. This paper briefly summarizes findings to date and assesses each alternative. All too often, scientists and engineers forget that because something is technically feasible and environmentally preferable, it is also acceptable from socioeconomic, political, cultural, and practical standpoints.

Capping in the Ocean

Technical Summary

The capping studies conducted in 1980-1981 and subsequent monitoring has shown that ocean disposal of dredged material in the New York Bight can be managed effectively by pinpoint dumping and capping when necessary to mitigate potential adverse environmental impacts (Suszkowski 1981, Mansky 1982). The physical, chemical, and biological monitoring performed concluded that (a) though pinpoint dumping, it was possible to place a 3-foot cap of uncontaminated dredged material over contaminated material in the New York Bight; (b) less than 4 percent by weight of the dredged material to be capped is dispersed during the dumping operation; (c) the sand cap is stable and should remain in place for 20 to 46 years under normal weather conditions; (d) the cap is an effective barrier to the migration of metals and organic compounds from the contaminated dredged material into the water column; and (e) bioaccumulation of contaminants from the dredged material is not likely to occur (O'Conner and O'Conner 1983) (Figure 1).

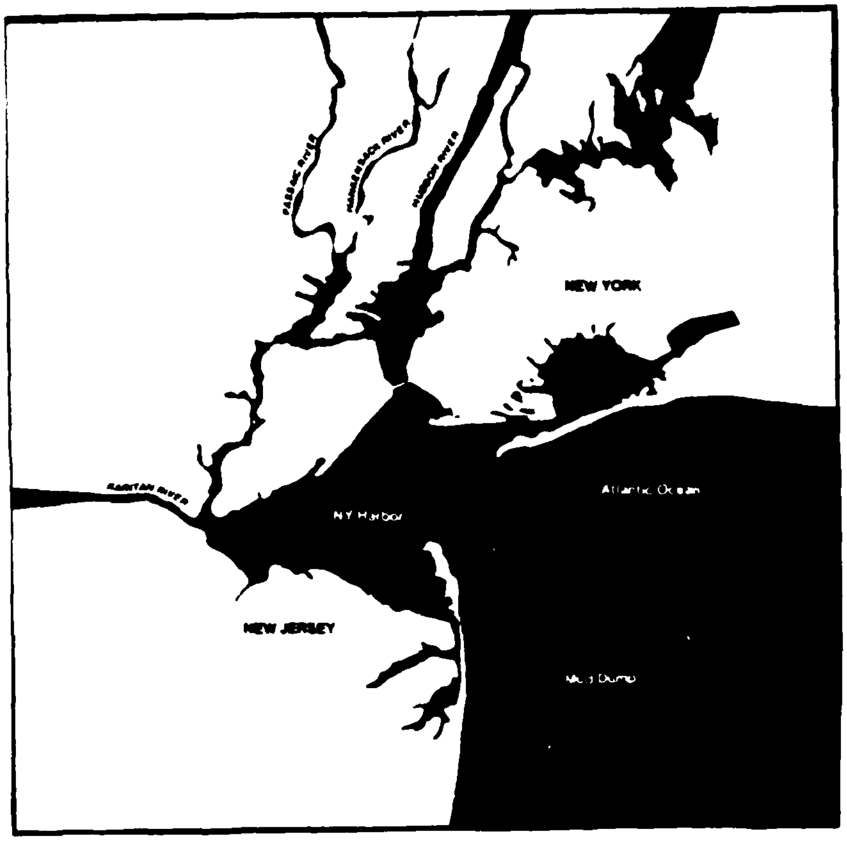

Figure 1. New York Harbor, showing major rivers and the Mud Dump Site

Practical Aspects

Even though all technical studies have shown that ocean disposal of dredged material can be managed effectively and is environmentally acceptable, there is strong sentiment, particularly from the New Jersey shore communities, that ocean dumping at the Mud Dump Site should cease. These communities usually seek political relief to their perception that they are being "dumped on" by the use of the Mud Dump Site. Frequently, there are articles in New Jersey newspapers which allege that ocean dumping of certain dredging projects is causing unacceptable environmental impacts to ocean and shore resources.

There have been several direct and indirect results from these concerns. The Mud Dump Site was designated by EPA from a maximum volume of 100 MCY, which the CE estimates will be used up by the mid-1990s. At the urging of Congressman James Howard of New Jersey, Section 211 was added to PL 99-662, which states that within 3 years EPA shall designate a new ocean disposal site for dredged material at a distance of at least 20 miles from shore that will be used for disposal of dredged material determined not to be "acceptable" at the Mud Dump Site. Acceptable dredged material is defined as "rock, beach quality sand, material excluded from testing..., and any other dredged material (including that from new work) determined...to be substantially free of

pollutants." This definition has a multitude of possible interpretations and has caused uncertainty as to the need and use of the new site, the number of sites requiring designation, the future use of the Mud Dump Site, and the future economics of dredging and dredged material disposal for the Port. Since EPA requires that an Environmental Impact Statement (EIS) be written for ocean disposal site designations, a 3-year time frame is optimistic. Implementation of Section 211 is currently being discussed by both the CE and EPA.

Subaqueous Borrow Pits

Technical Summary

Disposal in subaqueous borrow pits with capping has been determined to be a technically feasible and environmentally preferable disposal alternative (Bokuniewicz, Cerrato, and Hirschberg 1986). The ocean disposal capping studies previously described, as well as laboratory studies of the effectiveness of capping (Brannon et al. 1985), studies of capping operations in the Long Island and Puget Sounds (Sumeri 1984), and several field tests of disposal of dredged material in borrow pits in New York Harbor, led to this conclusion. It was determined that a small pilot project originally planned was no longer necessary. Efforts were then turned towards designing an operational borrow pit disposal program using either newly dug or existing borrow pits. Environmental clearances are currently being pursued to designate a borrow pit disposal site in New York Harbor (Figure 2). Because of limited volume available in a borrow pit disposal site, such sites will be reserved only for dredged material not suitable for unrestricted ocean disposal.

Practical Aspects

A number of years ago, the original pilot project involved disposal into one small section of an existing borrow pit offshore at Staten Island, New York, with plans to cap and monitor for 6 months to determine the environmental impacts. However, a local Staten Island conservation group, the Natural Resources Protective Association (NRPA), strongly opposed the pilot project because they considered the borrow pit to be a prime recreational fishing area. NRPA mustered public support and enlisted the aid of their local US Congressman and State elected officials to raise concerns with the New York District. They sued the State of New York for issuing a Section 401 Water Quality Certification for the project. A temporary injunction caused delays while the issues were argued in court. The State Supreme Court decided that there was enough "disparity of scientific opinion" to "hold these motions in abeyance" until a neutral scientific panel "mutually selected by the parties" determined the impacts of the pilot project and reported back to the court. New York State appealed the decision, but the Appeals Court ruled that it was not appealable because a decision had not been rendered, but merely delayed until the panel made its report. Efforts by the State to assemble a scientific panel acceptable to both parties failed, which further delayed the project.

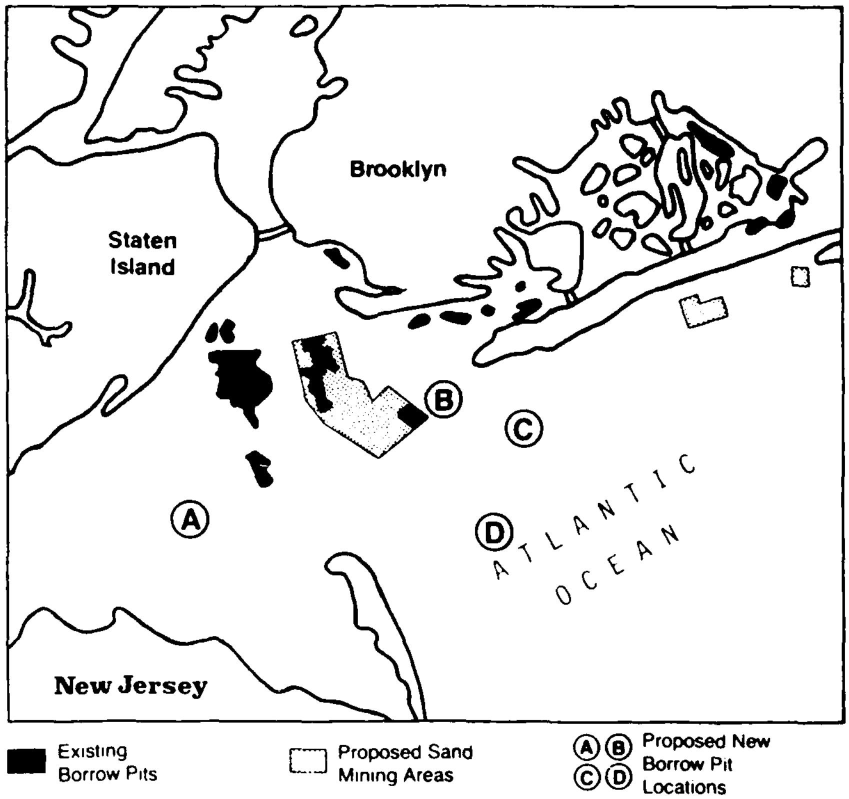

Figure 2. Locations being studied for the potential siting of a borrow pit disposal site.

Meanwhile, fisheries surveys of borrow pits in New York Harbor had been funded by New York District to determine in detail the resource potentially being affected by the pilot project. These surveys showed that although borrow pits did not support permanent fish populations and were not an important food source for migratory species, they did tend to congregate fish in higher numbers than the surrounding flat sandy bottom for most of the year (Pacheco 1983; NMFS 1984; Conover, Cerrato, and Bokuniewicz 1985). Based on this information, the State revoked the Section 401 certificate. New York District subsequently reapplied, but now was required to prepare a New York State EIS for the pilot project.

While these events were taking place, other completed research on the effectiveness of capping and borrow pit disposal (Brannon et al. 1985 and Sumeri 1984) indicated that the pilot project as planned was now no longer necessary. The questions it had been designed to answer had already been answered, and results showed that borrow pit disposal could be effectively and efficiently done. New York District suggested that all parties concerned work together towards developing an operational program of borrow pit disposal, selecting an existing pit or an area environmentally suitable for the construction of a new pit, or both. Both the State and the NRPA agreed to work with the District, although NRPA stated that while they were not opposed to

borrow pit disposal in principle, they did not want existing borrow pits used for disposal.

The State agreed to overlap regulatory processes to the maximum extent possible, and the District withdrew its second application for a Section 401 certificate, and applied for a third certificate for an operational program. The District began with Federal EIS preparation. At this stage, NMFS, EPA, and the States of New Jersey and New York all agreed to be cooperating agencies on the EIS. FWS has expressed their support and interest.

Containment Facilities

Technical Summary

Three types of offshore containment facilities are being studied: (a) large containment islands of 500 acres or greater, (b) small containment areas, and (c) wetlands stabilized areas adjacent to shore. Siting studies are still being performed for locating a large containment island. These studies include a fisheries survey and benthic invertebrate survey to compare species abundance in various areas of the Harbor. Three potential island locations have been identified in the Lower Bay of New York (Bokuniewicz and Cerrato 1984) (Figure 3). To maximize life of a containment island, it could receive only that dredged material not suitable for unrestricted ocean disposal. A 500-acre island used in this manner could have a 25-year life and hold up to 28 MCY.

Site screening for potential small containment areas and wetlands was completed by the District (US Army Corps of Engineers 1983a) (Figure 4), and only two small areas, one small island site, and one potential wetland site

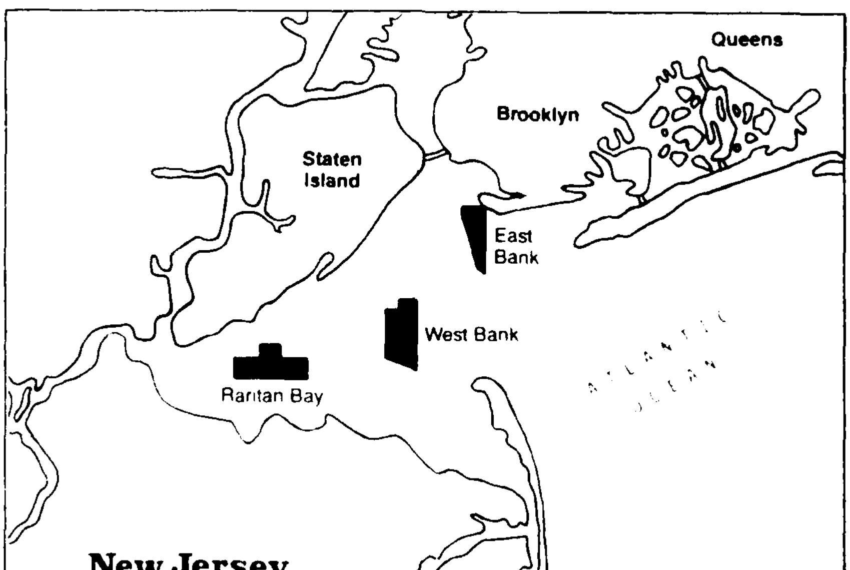

Figure 3. Potential large containment island sites

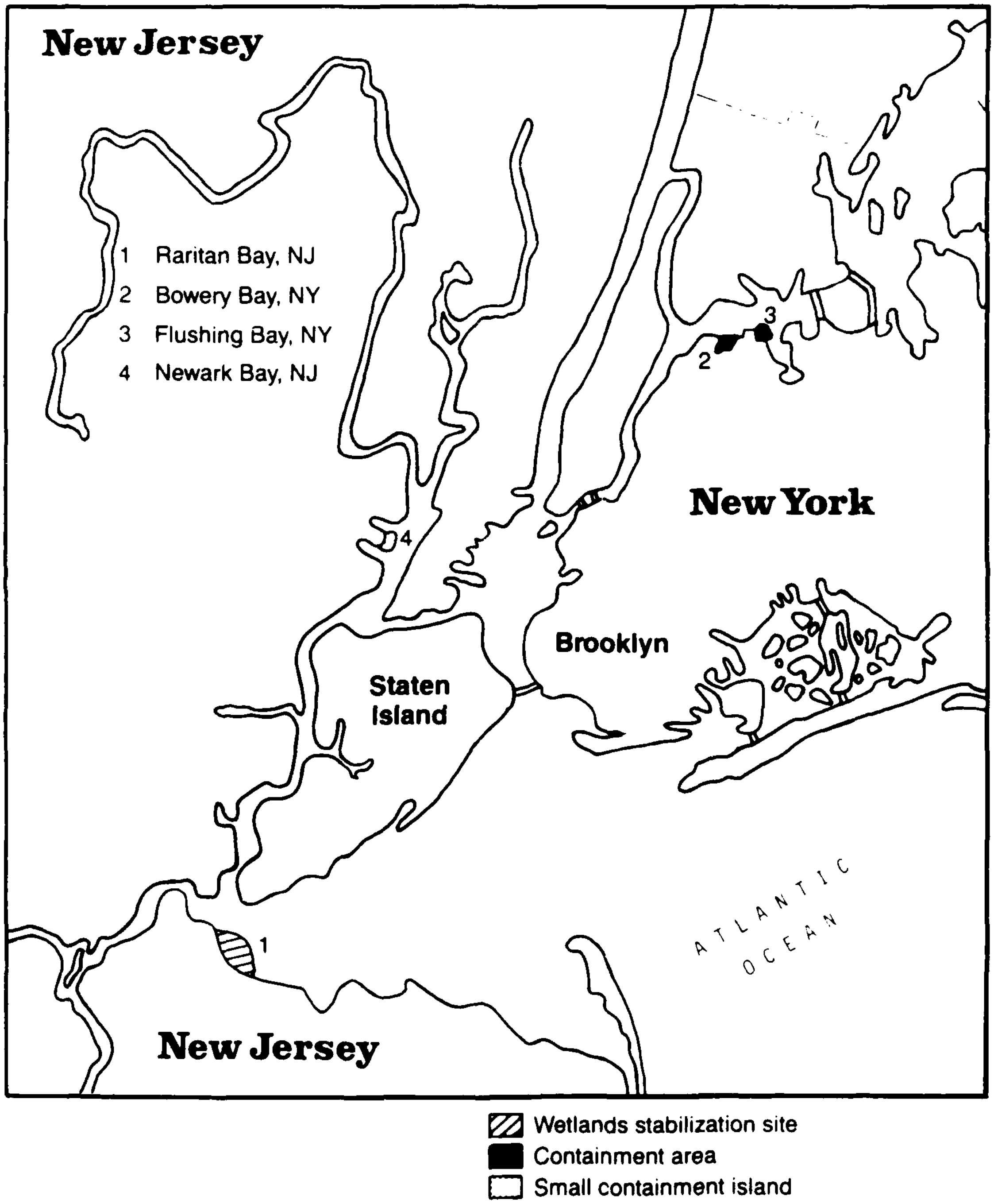

Figure 4. Potential small containment area/wetlands stabilization sites

were identified, all with very limited capacity. Combined capacity amounts to only about 25 percent of the large containment island.

Practical Aspects

A large containment island may be worthwhile for the District to pursue if it is restricted to dredged material that cannot be placed in the ocean. It is much more economical to construct one large island than to build the other small containment sites. In addition, any wetland site could only make use of uncontaminated material. For these reasons, small areas and islands and wetlands were determined to not be feasible as regional disposal options, but may be reserved for special cases or on a project-specific basis.

A large containment island is also a potential long-term disposal alternative, but implementation would require a cost-sharing local sponsor. State and port officials have expressed reluctance in assuming a leadership role in project implementation. As a result, New York District cannot proceed beyond the feasibility study and preliminary siting stage for an island despite its great potential for a long-term disposal site. Primary objections center around the controversial requirement in island construction in permanently converting bay bottom into upland/island habitat. Environmental action groups have already raised their concerns, and they would prefer to see an environmental use such as seabird nesting, a refuge, or a park as the ultimate use of such a site. Such ultimate uses do not inspire interest from developmental, State, or local sponsors who would cost-share such a project. In addition, sponsor needs could conflict with the long-term disposal plans of the District, in that such a sponsor would want the site filled quickly so it could be developed.

Upland Disposal/Sanitary Landfill Cover

Technical Summary

Upland disposal requires transporting dredged material to a confined, diked site on land for dewatering. Use as sanitary landfill cover involves use of dewatered material on a daily basis, or an intermediate or final cover on landfills. State law requires that landfills be covered at the end of each working day with clean material for public health reasons, amounting to millions of yards each year for regional fills. Preliminary feasibility studies determined that dewatered dredged material was environmentally suitable for landfill cover (Malcolm Pirnie Inc. 1982). This includes dredged material not suitable for ocean disposal.

Approximately 300 upland areas with less than 33-percent vegetative cover, within 100 miles of Upper New York Harbor, were identified in parcels of from 10 to 1000+ acres (Leslie et al. 1980). Site screening of these 300 areas eliminated all but 2 areas (Figure 5). All other sites were eliminated due to land use conflicts or environmental considerations. Their limited volume (11 MCY combined) made their use impractical unless the material was dewatered and used as landfill cover.

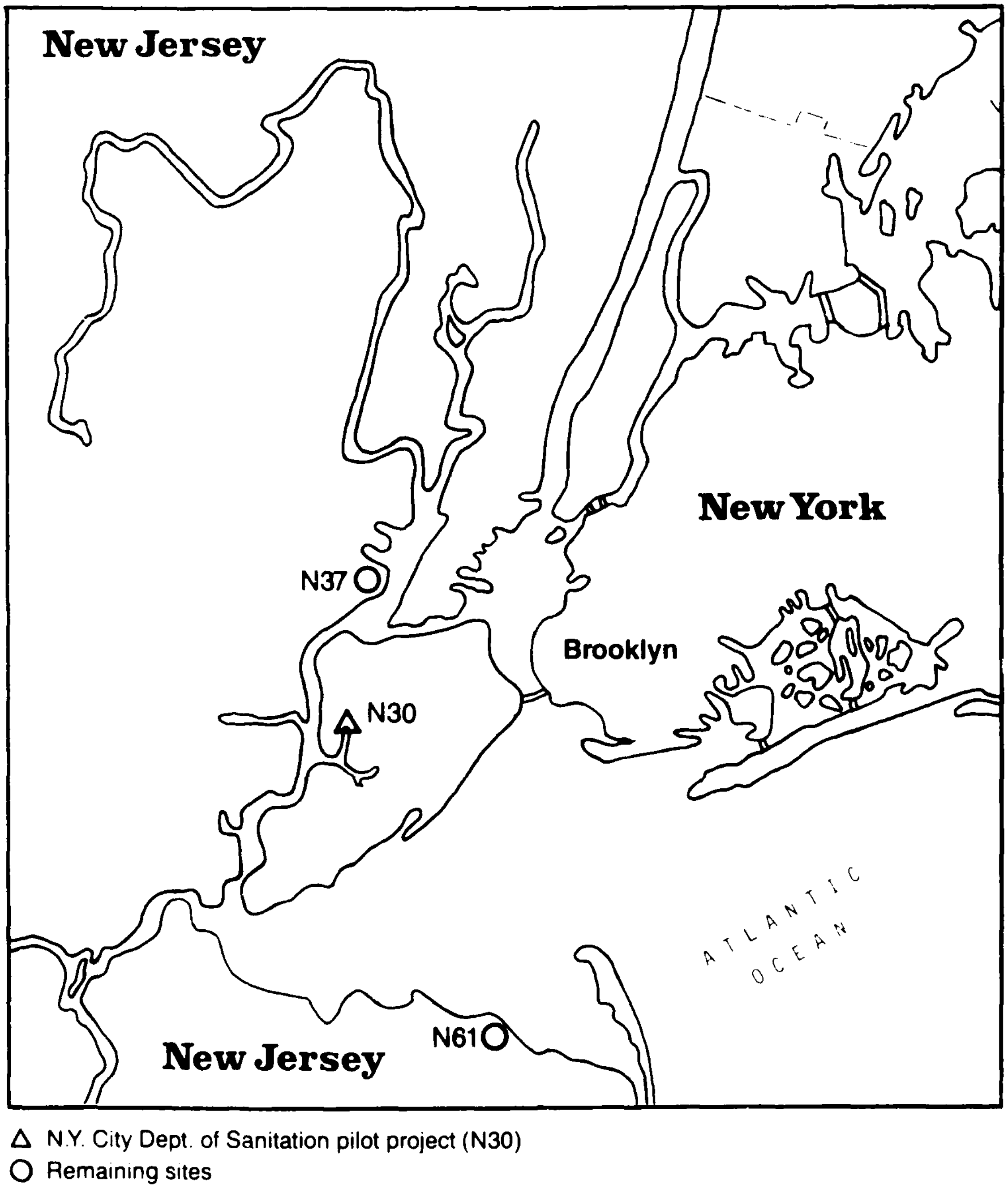

Figure 5. Potential regional upland disposal/dewatering sites

Practical Aspects

That only two upland/dewatering sites remain under consideration is to a large extend a reflection of waterfront property values in this area. Most large tracts of vacant land near the Harbor are already committed to port or development projects. With 7 million people in New York City and 11 million in the Greater New York/New Jersey area, urban pressures on waterfront property are very great. As a result, most landowners are not willing to commit their land for use for dredged material disposal or landfill dewatering. Some were willing if a short-term use was intended, and especially if adjacent low-lying areas (wetlands) were filled. They were apparently looking for free landfill and the needed environmental clearances so that they could develop the site commercially. These sites were excluded from further consideration under those conditions.

Site N37 is a 105-acre lot and is purportedly available for purchase for over $6 million. The lot is prime waterfront, zoned for port/industrial/manufacturing use. This lot has the same institutional constraints described under Containment Facilities, and no local cost-sharing entity has taken a lead role in its purchase.

Site N61 is a 32-acre lot and is purportedly not available for purchase. It is, however, available for limited use providing the landowners can develop it later. The lot is an old disposal site for material from Shoal Harbor and Compton Creek, Federal navigation projects, but is no longer used for that purpose due to landowners' desire to put the material in adjacent wetlands they also own. Its use for landfill dewatering is doubtful, and transport costs from either site would be very expensive.

The only economical way to use dewatered dredged material for landfill cover is to dewater the material adjacent to the landfill site. This is being tested in a pilot project at the New York City landfill at Fresh Kills, using dredged material generated from New York City dredging projects.

Beach Nourishment

Technical Summary

Beach nourishment is a common practice on recreational beaches to replace sand lost to erosion. It generally involves hydraulic placement from an offshore borrow area. In the NY/NJ area, it sometimes includes dredging of beach quality sand from Federal navigation channels. Beach nourishment is usually technically feasible if the material is approximately 90-percent sand or greater. Only a few channels within the District contain sand of that quality, amounting to less than 10 percent of the annual dredging (Figure 6). Beach nourishment is an environmentally acceptable alternative within the District (US Army Corps of Engineers 1983b).

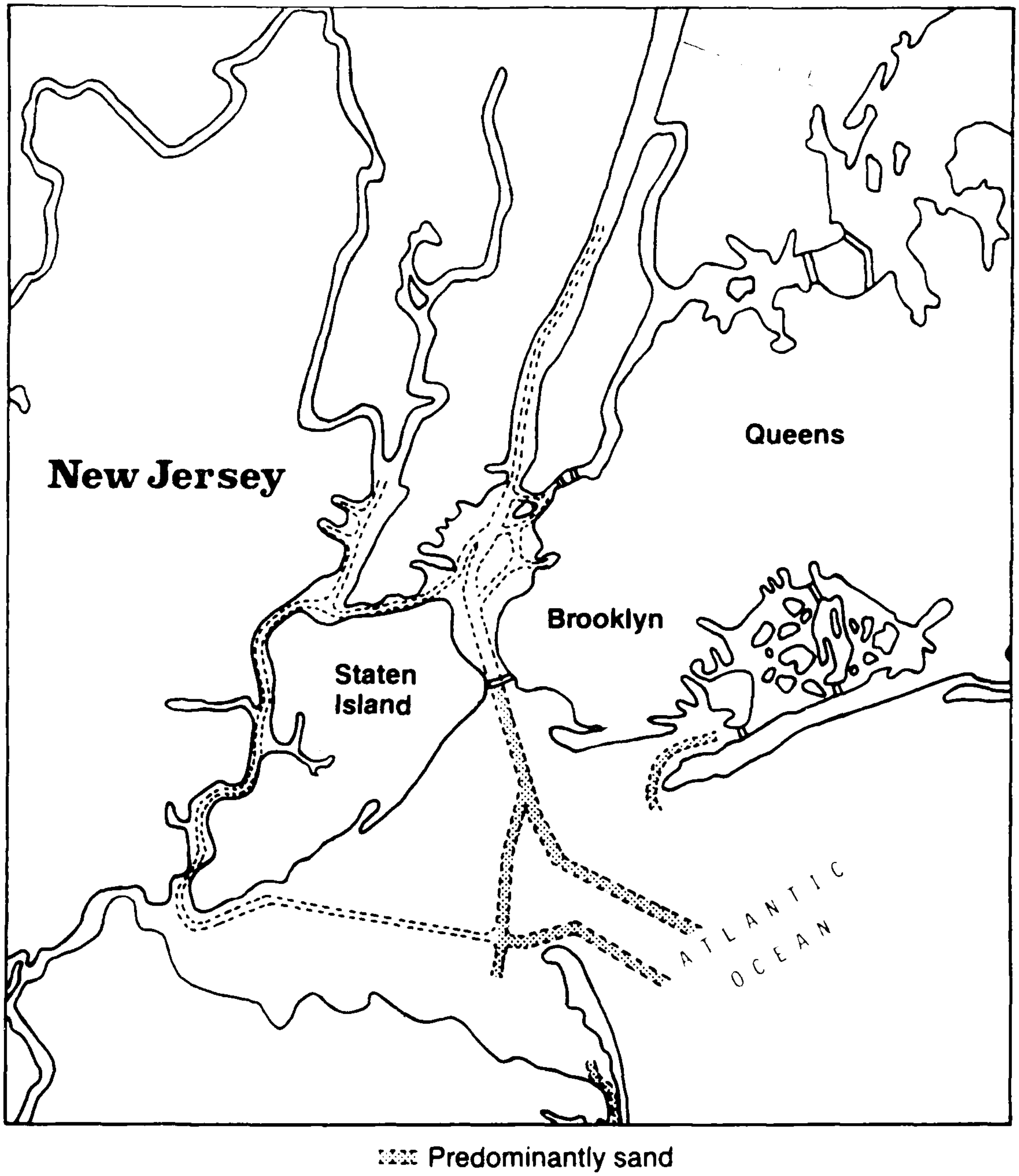

Figure 6. Federal navigation channels which contain sand potentially suitable for beach nourishment

Practical Aspects

The sand dredged from District channels is usually more fine-grained than is desirable for beach nourishment and erodes much more quickly than coarser grained sands. Costs of beach nourishment generally are at least \$2 to \$3 per cubic yard more than the cost of ocean disposal. It is probably more practical for a local sponsor to go to an offshore borrow area rather than the shipping channel to obtain beach nourishment sand.

Certain restrictions are placed on the CE where beach nourishment is concerned. PL 94-587 requires that sand generated from Federal projects can be placed on beaches only when it is deemed to be in the public interest and that any increase in costs be paid for by local interests. PL 99-662 recently modified this so that local interest must pay only 50 percent of the increased costs. This still requires considerable funding from local governments and other entities, and often is not possible.

Beneficial use of dredged sand is encouraged where possible. For example, the demand for sand as fill or construction material has exceeded the nearby upland supply, and private business concerns now are permitted to mine sand from the entrance channel to the harbor, rather than the CE carrying that sand out for ocean disposal. Furthermore, the dredging required to mine the sand keeps the CE from spending Federal funds to dredge that channel. The States of New York and New Jersey collect royalty fees, and the dredging company makes a profit from the sale of the sand for use as aggregate material.

In addition to the above, two other uses of dredged sand are very practical: (a) placing the sand into the littoral drift system along the beaches to slow down-drift erosion and (b) using the sand for capping at the District's ocean dumping site.

Conclusions

The several studies discussed in this paper have arrived at a number of conclusions, and have demonstrated that:

a. There is a continued need for ocean disposal for the majority of dredged material from the Port of New York and New Jersey. None of the alternatives to ocean disposal that were studied, either singly or in combination, would be able to accommodate all dredged material generated from the port for a number of years.

b. Ocean disposal can be managed effectively and in an environmentally sound manner through techniques such as pinpoint dumping, capping, and environmental monitoring.

c. Any alternative to ocean disposal must be able to accept the limited volumes of dredged material which are not acceptable for ocean dumping or require capping. There appears to be two potential alternatives which will meet this criterion: (1) subaqueous borrow pits for short-term needs and

(2) a large containment island for long-term needs. All other alternatives seem to be suitable for special case dredging.

d. The acceptability of ocean disposal is a critical issue. Continued political pressure to close the Mud Dump Site or move it farther offshore has economic implications to the efficient dredging of the port. The exact magnitude of these impacts depends on the location and planned use of the future disposal site and any restriction placed on future use of the Mud Dump Site.

e. The acceptability of subaqueous borrow pits as disposal areas depends largely upon the exact location of the pit selected and whether an existing or a new pit is used.

f. A large containment island is not possible to implement unless specific institutional arrangements are made between the States of New York and/or New Jersey (or another local entity) and the Federal government. To date, no interest in pursuing this goal has been expressed by any local agency.

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LONG-TERM DISPOSAL SITE PROBLEMS AND CONFLICTS: ALTERNATIVES FOR THE FUTURE

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When I started to write about the who, what, why, when, and how of dredging and disposal, particularly with regard to potential alternatives, I realized that we are talking about the blind man and the elephant. What we are calling dredged material here has other names in other situations. It is turbidity when I am dealing with the Chesapeake Bay. It is bed load and other issues when I am dealing with the Potomac River, and what effect they may have on living resources. There are a lot of things to tie together here. I ended up deciding that I would like to pass on two ideas to you.

The first is basically that any effective consideration of dredged material in the future must deal not only with where you are going to put the dredged material, but how it got there in the first place. The sediment that leads to a dredged material disposal problem has an origin in the upper portion of the watershed. At some point in time it was all part of the land, and repetitive dredging of this material that washes down seems an inefficient way to handle the overall problem.

My favorite story is of Sisyphus, who was condemned to Hades to forever roll a heavy stone uphill, only to have it fall back down again, and have to start all over. That is the way it is with dredged material. There are different ways we can handle dredged material once it gets downhill, but our basic problem is at the top of the hill--how can we treat the watershed to prevent so much erosion and sedimentation?

This effort is going to require all of us, including involvement of other groups and disciplines not represented in this workshop. If fact, it may behoove us to have another workshop which addresses the source of dredged material and how to prevent it from ever reaching the rivers, estuaries, and bays. There is no single answer to this problem. In some cases, it may be as simple as reforestation. In others, we may be able to keep a lot of material in place by changing or modifying a variety of land use practices. Studies show that forested watersheds release only 1/10 as much sediment and nutrient loads as unforested watersheds. Material may be trapped on its way to the estuary. This will include legal and economic considerations. We will have to come to grips with road construction practices, housing and urban development, and other major urban and industrial causes of erosion as well as that from agriculture and forestry lands.

Unfortunately, once material makes its way to Chesapeake Bay, we find that it moves around the bay and must be dealt with over and over again. We are seeing the decline of resources in the bay, partly due to the effects of this material--turbidity, excess nutrients, and contaminants.

The second idea I want to discuss is the long-term management of dredged material. As we all know, in New York and other areas, traditional disposal sites are becoming increasingly difficult to find and obtain, especially in the coastal plain. These areas have always functioned as sites for urban and industrial expansion. As a result, upland disposal sites are now more costly and much more scarce. Recognition of the importance of biologically productive wetlands, shallow water habitats, and submerged aquatic vegetation beds mandate that we look at other solutions.

In the future, many opportunities exist for a long-term productive use, including beach nourishment, marsh creation, habitat development, multiple use of confined disposal facilities, etc. Dewatering and rehandling of dredged material is encouraged to prolong use of disposal sites. Long-term dedicated sites have the economic advantage of not requiring lengthy environmental assessments nor a reexamination of engineering feasibility, thus saving Federal dollars.

In summary, the FWS supports methodologies which incorporate watershed analysis as an integral part of dredged material management, long-term disposal site use, and beneficial use of the dredged material from those sites. I want to close by listing the FWS Dredging Policy Guidelines for Chesapeake Bay.

FWS Dredging Policy Guidelines

Because of the continuing and pervasive decline of Chesapeake Bay resources and the quality of the Chesapeake Bay, there is an overriding need to protect existing habitats and organism stocks for future restoration efforts. In situations where there are conflicting uses for shallow water habitat, decisions regarding dredging must take into account the immediate and cumulative impacts of the proposal on the natural resources and the consistency with the Chesapeake Bay restoration effort. Although dredging has historically occurred due to shifting sands and shoals, the frequency and number of projects have risen due to a population increase and the lack of deep water areas on many tidal creeks. For purposes of this guidance, shallow water is defined as that area extending from the mean high water line to a depth of 2 metres (6.6 feet) below low water. This corresponds with the boundary between wetland and deep water habitat as developed by Cowardin et al. (1979).

This shallow water area ranges from the intertidal zone to the subtidal and includes many habitat types from shorelines, mud flats, sand, rock and cobble beaches, emergent vegetation stands, submerged aquatic vegetation beds, and open water. Flora typical of this shallow water includes cattail, cordgrass, saltmeadow hay, reedgrass, eelgrass, widgeongrass, pondweed, redhead grass, horned pondweed, hydrilla, etc. Fauna found in these areas includes plankton, worms, crustaceans, snails, crabs, fish, oysters, clams, passerine birds, wading birds, ducks, geese, swans, and mammals.

Dredging in tidal waters requires permits from both State and Federal programs; therefore, these guidelines are intended to clarify the criteria with which permit applications will be evaluated. The restoration of the

Chesapeake Bay is a paramount goal in the programs of all of these groups. In addition, they recognize that individually minor actions have had and will continue to have a cumulative and degrading effect on the Chesapeake Bay. Although permits will be considered on a case-by-case basis, the following factors will enter into the decision made on any dredging project:

a. Dredged Material Disposal Site. An upland disposal site, preferably one already altered or one with little or no wildlife value is required. Capacity of the site must be adequate to hold initial dredge volume and also any projected volume from maintenance dredging. Other disposal options that substantially benefit fish and wildlife resources will be considered. Proper erosion control techniques will be employed.

b. Historical Use/Previously Existing Channel. Generally, maintaining existing and continually used channels, slips, and boat accesses will not be opposed provided proposed dredging does not exceed historical dimensions.

c. Submerged Aquatic Vegetation (SAV). Because of the important habitat that SAV provides for aquatic organisms as well as its water quality benefits, dredging will not be allowed within 10 feet of an existing or potential SAV bed or on a 3:1 slope, whichever is greater. Since bay grasses are periodic in occurrence and transitory in nature, historical records will be used to estimate potential distribution.

d. Best Management Practices. In many situations, the sedimentation problems which generate a dredging request are not being corrected. As such, dredging is only "reacting to a symptom." In those cases where the source can be reasonably identified, the permit for dredging, if issued, will contain conditions requiring that Best Management Practices be applied to control sedimentation at the source and/or within the watershed.

e. Method of Dredging. In all situations, Best Management Practices must be applied to minimize the adverse impacts of dredging. Generally, hydraulic dredging is the preferred method, while clamshell or dragline dredging causes the greatest amount of disturbance to aquatic resources.

f. Emergent Vegetation. Emergent vegetation serves many functions ranging from primary productivity; nutrient transport; providing fish, other aquatic organisms, and wildlife habitat; shoreline protection from wave energy; and providing aesthetic enjoyment. Because of the national importance of our wetland resource as defined within the FWS publication "Classification of Wetlands and Deepwater Habitats of the United States," these areas will not be disturbed, and an adequate buffer zone of no dredging will be maintained from them.

g. Cumulative Impacts and Secondary Impacts. It is important that both secondary impacts and cumulative impacts of the proposed dredging be addressed by the applicant. The effects of any dredging proposal will be assessed in relationship to other existing and potential permit activities in a particular water body. In addition, secondary impacts (e.g., spur channel dredging) will also be evaluated.

h. Time of Year Restrictions. Because of the spawning characteristics of fish, shellfish, and other organisms in the bay, there will be time-of-year restrictions imposed on any activity in shallow water that will potentially disturb reproductive activity or survival of eggs and larvae.

i. Alternative Review. Each application for dredging must be accompanied by an analysis of alternatives to the proposed action. These alternatives should include but not necessarily be limited to: piering, community marina, zonation mooring, alternative channel locations, and no action.

LONG-TERM DISPOSAL SITE PROBLEMS AND CONFLICTS:
EVALUATING SEAFLOOR IMPACTS USING THE BENTHIC RESOURCE ASSESSMENT TECHNIQUES (BRAT)

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Introduction

CE activities, particularly dredged material disposal, affect the sedimentary and biological character of the seafloor (Figure 1).

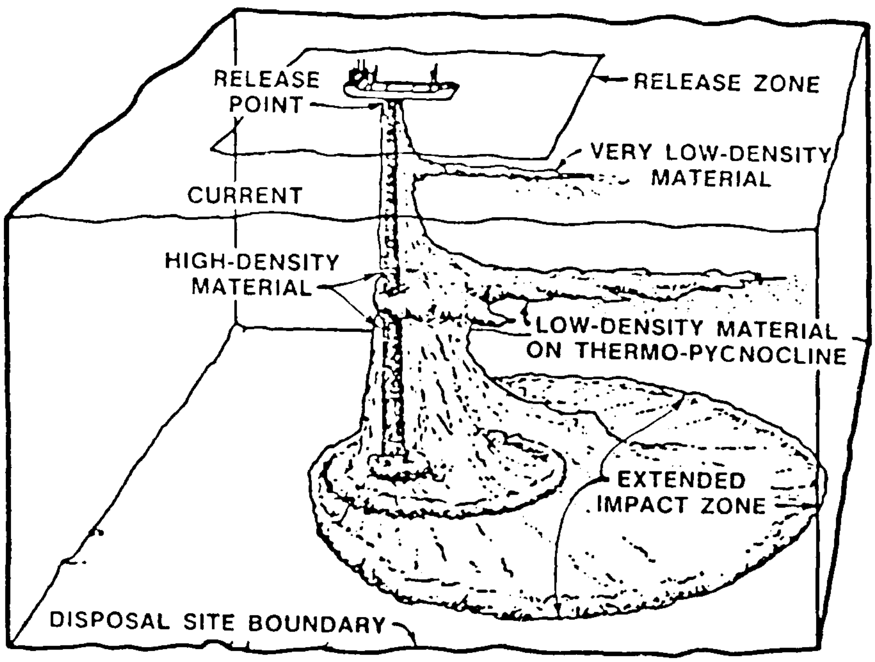

Figure 1. Hypothetical disposal event showing trajectory of dredged material through the water column and dispersion on the bottom

An often expressed concern about these activities is their immediate and long-term effect on the value of the seafloor as a feeding area for commercially and recreationally important bottom-dwelling fishes. The WES has developed a set of procedures, collectively called the Benthic Resource Assessment Technique (BRAT), to address this concern (Lunz and Kendall 1982, Clarke and Lunz 1985).

BRAT Rationale and Methods

The BRAT recognizes a condition well-documented by marine biologists that there is a general pattern in biological responses following a seafloor

disturbance (Figure 2): with the passage of time following the disturbance, an increase in both the size of the animals comprising the bottom (benthic) community and the depth of biological activity in the substrate occurs.

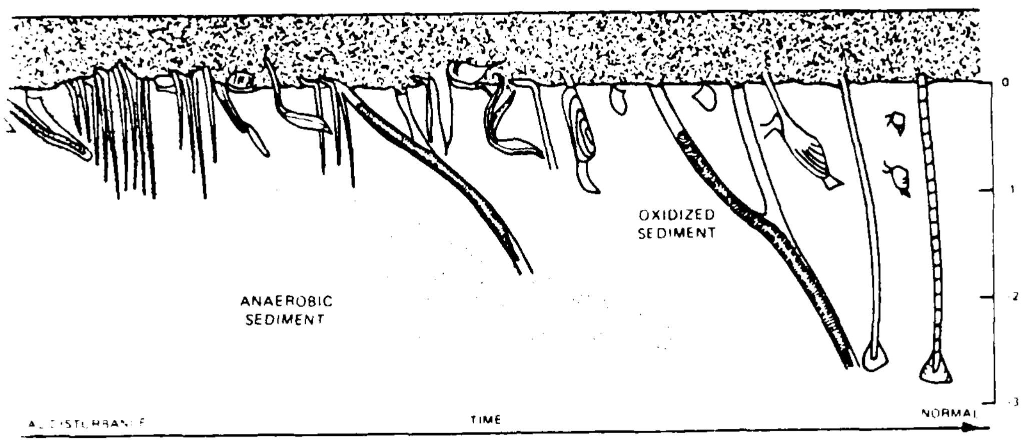

Figure 2. Diagram of the development of organism-sediment relationships over time following a seafloor disturbance. After disturbance, numerous, small, surface-dwelling organisms are initially established and through time are replaced by larger, deeper mud-dwelling species (adapted from Rhoads and Germano 1982)

The BRAT further takes into consideration that underlying differences in the diets of different fish species, different sizes of the same species, and the same species and sizes feeding in different locations may be explained by the tendency of most fishes to eat prey they can most efficiently detect, capture, and ingest. The potential for prey detection, capture, and ingestion collectively define prey availability. In the BRAT, the foraging depth (Figure 3) of a fish or a group of fishes and the size range of prey consumed by a given group of fishes (Figure 4) are used to describe a fish's prey-exploitation strategy. Knowledge about these strategies allows an investigator to estimate the portion of a particular bottom-dwelling (benthic) invertebrate assemblage that is available to a selected fish or group of fishes. Agencies concerned about alterations in the fish-food (forage) value of the seafloor can document and to some extent predict changes in value through time since the disturbance.

The BRAT requires depth- and size-distribution information on the benthic invertebrate community. This information is obtained by collecting seafloor samples using a box core (Figure 5). Information about the prey exploitation strategies of fishes inhabiting a project area is obtained by analyzing the stomach contents of trawl-caught fishes (Figure 6).

A BRAT Application

The BRAT was applied to the Foul Area Disposal Site (FADS), which is located in the Atlantic Ocean off the coast of Boston, Massachusetts (Lunz

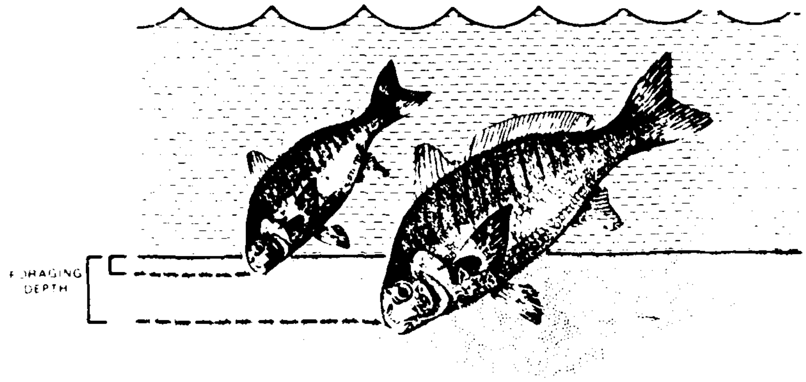

Figure 3. BRAT takes into consideration the foraging depth of a given predator, which is defined as the depth in the sediment column to which prey are removed

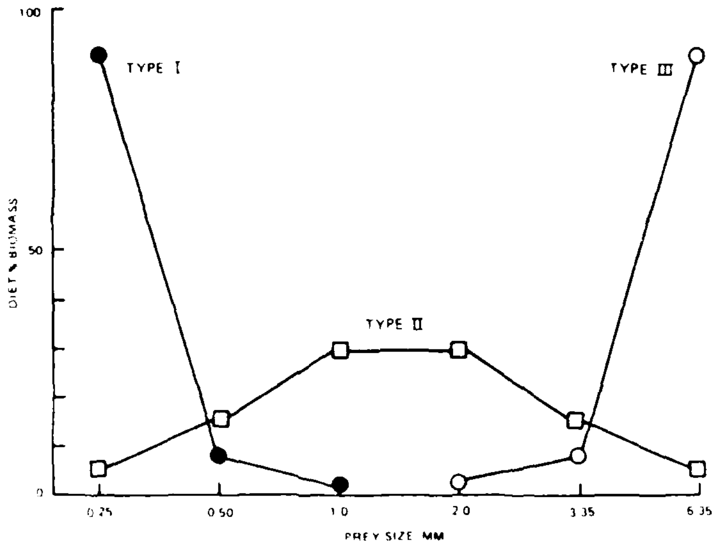

Figure 4. Hypothetical predator groups based on prey size selectivity. Predators displaying Group I prey size exploitation feed predominantly on small prey items, Group II predominantly on intermediate size prey items, and Group III predominantly on large prey items

Figure 5. The Gray-O'Hara box core used to collect BRAT section benthic samples

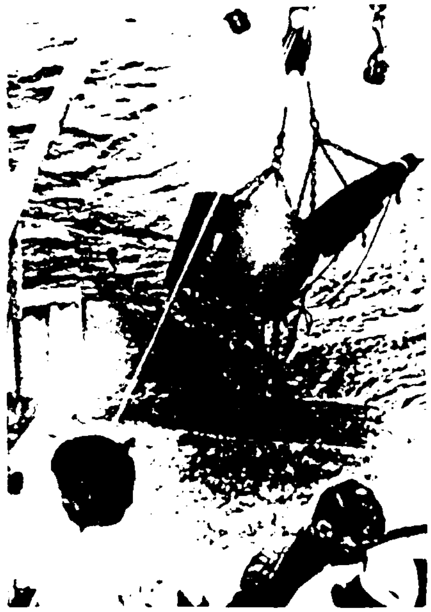

Figure 6. Trawl used to collect fish for the stomach contents analysis

1986) (Figure 7). This general area is an important commercial fishing ground for a variety of flatfishes and other types of bottom-dwelling fishes. The investigation was designed to document the effect of dredged material disposal activities on forage habitat value of the seafloor. The results of this study, which are based on a single cruise conducted in October 1985 approximately 6 months following dredged material disposal, are described in the following paragraphs.

Analyses of fish-stomach-contents samples identified five prey exploitation strategies. For example, predators displaying a small-sized prey exploitation strategy were assigned to Group I (Figure 8), whereas, predators displaying large-sized prey exploitation behavior were assigned to Group III (Figure 9).

The size and depth distributions of biomass of benthic communities inhabiting the area of the seafloor disturbed by dredged material disposal and the reference area are depicted in Figures 10 and 11, respectively.

The results of the BRAT provided an estimate of the amount of potentially available food (resource value), expressed in grams of food per square meter, (a) on the dredged material "mound" within the disposal site, (b) on the seafloor away from the mound at the edge of the disposal site, and (c) on the seafloor at the reference area (Figure 12). The resource values of the three locations were compared for the single seasonal observation and the fishes examined. Based upon this benthic and fish diet information, we concluded that (a) dredged material disposal operations within the FADS altered the character of the benthic community and (b) the altered community condition

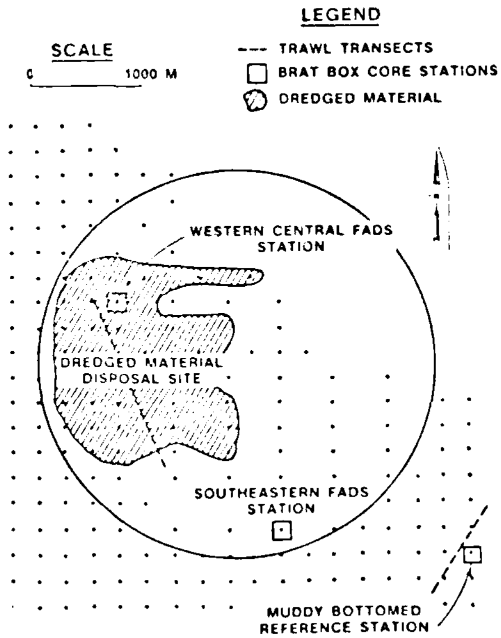

Figure 7. Trawl and box core stations at the Foul Area Disposal Site

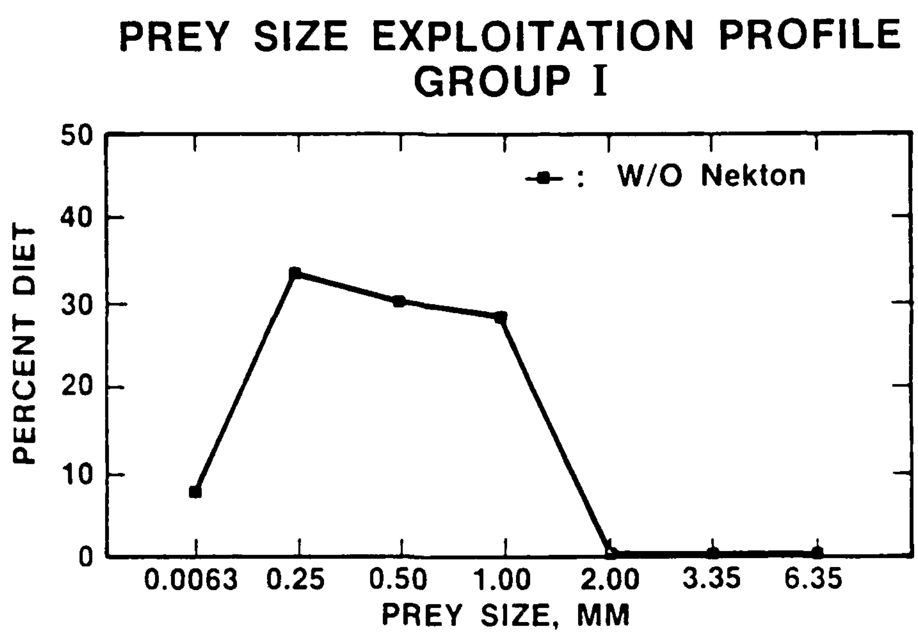

Figure 8. Prey size exploitation pattern shown by smaller size classes of American plaice and witch flounder

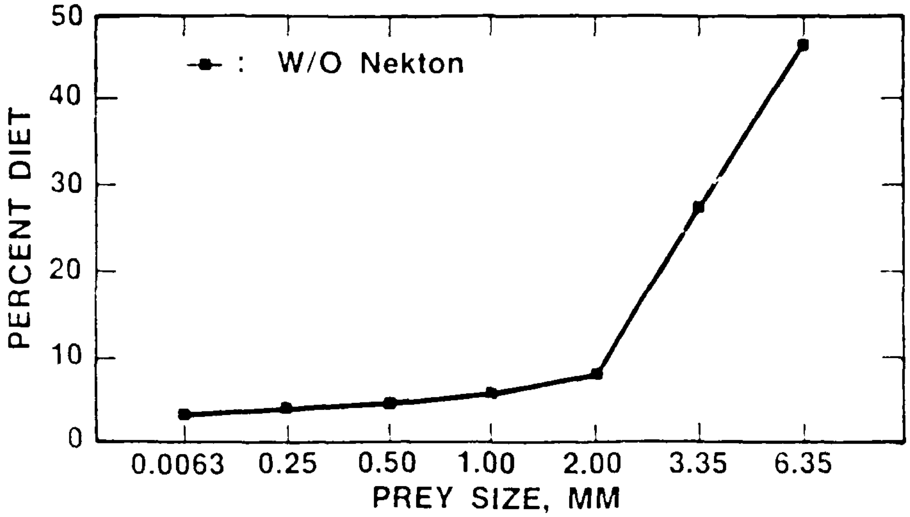

Figure 9. Prey size exploitation pattern shown by larger size classes of American plaice and witch flounder

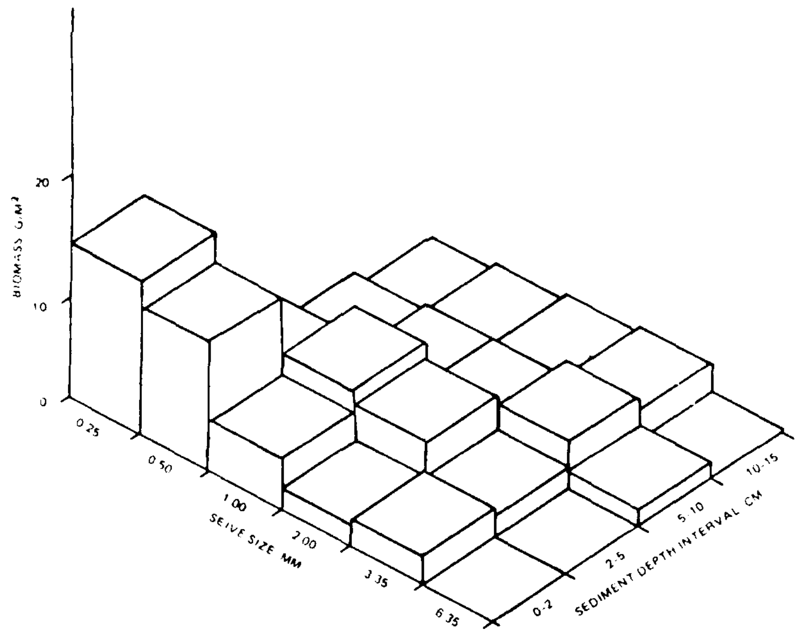

Figure 10. The size and depth distributions of biomass of benthic communities inhabiting the area of the seafloor disturbed by dredged material disposal in the Foul Area Disposal Site

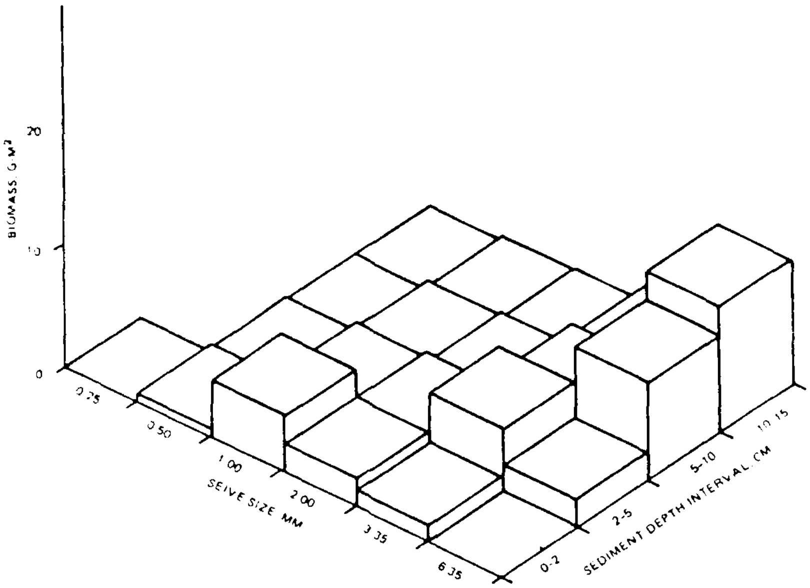

Figure 11. The size and depth distributions of benthic communities inhabiting the reference area proximal to the Foul Area Disposal Site

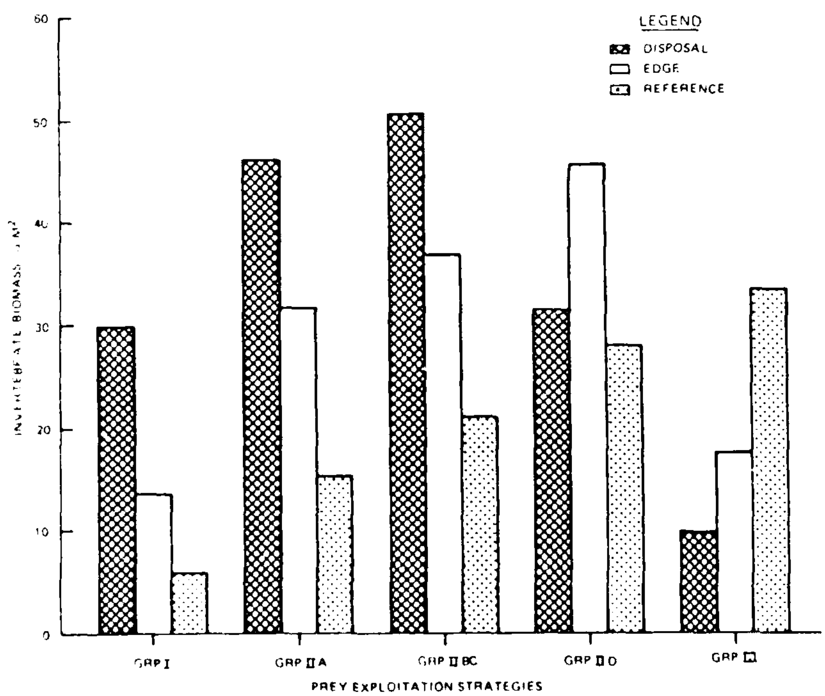

Figure 12. Comparison of resource (trophic) value estimates for various predator groups among the study sites for the Foul Area Disposal Site

represented a trophic value enhancement for all sizes of fishes present at the time of the sampling with the exception of American plaice greater in standard length than [illegible] centimetres and witch flounder greater than 30-centimetre standard length.

Discussion

The BRAT is a technique or evaluation tool which can be used to provide comparable numerical values of seafloor bottoms in terms of their potential for providing food for bottom-feeding fish. It is a tool that can be used in the decision-making process to evaluate alternative sites for construction or dredged material disposal. BRAT can also be used to test the influence of different thicknesses of disposal material, to examine effects of the frequency of disposal (how often to dispose at a site), and to evaluate seasonal effects of disposal (when to dispose at a site). To date, the technique has been applied in the North Atlantic (Lunz 1986) and mid-Atlantic (Kendall and Lunz [illegible]). It is currently being applied in the North Pacific in Puget Sound (Clarke 1986) and in the South Pacific in California. BRAT is being tested in California as a method to determine potential food resource value of estuarine intertidal mud flats for wading birds and shorebirds.

The Benthic Resource Assessment Technique can be used to determine the least harmful or the most beneficial use of dredged material. The goal of dredged material disposal, based on solid ecological principles, would be to maximize the availability of food production to fish by minimizing recolonization times or by developing of substrates with a low food resource value.

Conclusions

The Coastal Ecology Group of the WES has developed a set of procedures to take benthic characterization information and produce semiquantitative estimates of the potential trophic value of soft-bottom habitats. These procedures are called the Benthic Resources Assessment Technique (BRAT). As presently configured, the BRAT can be applied under any circumstances in which the preproject or postproject fishery value of an unvegetated soft bottom is an important issue. Although developed primarily for application to subtidal estuarine and coastal marine systems, the BRAT has potential utility in riverine and lacustrine habitats as well. A trial of the BRAT for estimating the value of mud flats for shore and wading bird feeding is in progress at this time. BRAT shows great promise for this type of application.

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Acknowledgments

The BRAT was developed at the WES with funding support from the CE's Environmental Impact Research Program. The application of the BRAT at the Foul Area Disposal Site was supported by the New England CE Division.

QUESTION: How will you select the Districts to be used as models for LTMS?

DR. KLESCH: My understanding is that a letter will go forward to Districts and Divisions requesting that they put together a proposal, from which final selections will be made.

QUESTION: What kind of response are you getting from the State regulators as far as using the dredged material for any particular use?

MR. TAVOLARO: State regulations don't consider dredged material any different from a contaminated material; therefore what may prove feasible from a technical and engineering standpoint often does not become an operations reality due to legal and other constraints.

COMMENT: It sounds like time for Jack Buzzi to make one of his timely deals!

QUESTION: Where you increase your activity in the upper surfaces and you get small forage fish in there, doesn't it follow that the larger fish will come in to feed on the forage fish?

MR. NELSON: You're absolutely correct.

QUESTION: You haven't seen an increase in biomass productivity in those areas so far?

MR. NELSON: Our only measure with the BRAT is availability of food. We made the assumption that the fish would be there if their food sources were present in sufficient quantities.

QUESTION: You say small fish feed on the bottom or on the surface?

MR. NELSON: Food resources encourage small fish to feed on the surface of the bottom, not the water surface.

QUESTION: Wouldn't you do better to set up size categories of the fish you are finding?

MR. NELSON: That's generally what we are doing. I didn't get into all the details of the BRAT model in this brief presentation.

CLOSING REMARKS

COL Martin W. Walsh Jr., District Engineer
US Army Corps of Engineers
Baltimore, Maryland

Well, the longer we went into this conference, the hotter it got! Now that we've all gotten to know each other, maybe we should continue for another few days. It has certainly been a real privilege and a terrific experience for Baltimore District to host this conference, and a fine experience for me personally. I don't often have this long to devote to any one topic in the course of my duties as District Engineer.

We have heard some very informative presentations by MG Hatch, BG Williams, and Mr. Rees. These have been learning experiences as well. It's always a privilege for me to listen to Mr. Bill Murden, who is a great man with worldwide experience. I'm very pleased to see all of us--scientists, engineers, and other professionals--talking to one another about a problem and an opportunity that concerns us all--dredged material disposal and its beneficial use as a resource material.

We with apparent conflicting interest are getting a lot done. Talk is cheap, and a lot of real work has gone on before. There's plenty of applied work waiting ahead for us. Our challenge is not to close our minds to change, innovation, tried-and-true methods. We have to advance the state-of-the-art, or the state-of-the-daring, if you will. Certainly we should not go home and dismiss what we've heard here. Remember the people you met, the contacts you made. Keep talking to each other!

Before we adjourn, I have many people I want to thank for their hard work in making this workshop happen. First of all, the speakers were outstanding and contributed much to the the technical success of this meeting.

Robert Gore deserves a special round of applause and special thanks, because he was the overall coordinator, the director, producer, etc., that brought this meeting together. He and his coworkers did all the trench work--hotel arrangements, etc. I certainly want to thank Harold Nelson, Glenn Earhart, and Bob Blama, among others from Baltimore District, who were major contributors to this meeting's success. There are many people in Baltimore District who worked on this, and I hope they will forgive me if I fail to mention them individually.

This was a team effort. There were other agencies involved, and our sister Districts and NAD. Our planning committee consisted of Carol Coch of New York District, Tom Schina of Philadelphia, Tom Yancey of Norfolk District, Mary Landin of WES, Bob Carlson of NAD, and Dave Mathis of WRSC-D. I'm sure I missed some people, and I think we need to give us all a utility infielder round of applause.

Don't forget the field trip to Hart-Miller Island tomorrow. I know you are going to enjoy the day. I thank each of you, and I hope you have enjoyed your stay in Baltimore.

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